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U.S. Army Toxic and Hazardous Materials Agency

Enhanced Preliminary Assessment Report:

Fort Wingate Depot Activity Gallup, New Mexico

March 1990

prepared for

Commander
U.S. Army Toxic and Hazardous Materials Agency
Aberdeen Proving Ground, Maryland 21010-5401

prepared by

Environmental Assessment and Information Sciences Division
Argonne National Laboratory
Argonne, Illinois 60439

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Argonne National Laboratory has conducted an enhanced preliminary assessment of the Fort Wingate Depot Activity at Gallup, New Mexico. The objectives of the enhanced preliminary assessment include: identifying and characterizing all areas, facilities, and operations with respect to known or suspected releases of contaminants to the environment, identifying areas of contamination that may require immediate remedial action, identifying those areas which may require additional investigation, identifying other actions that may be necessary to address and resolve all identified environmental problems, and identifying other environmental concerns that may present impediments to the expeditious transfer of this property. Fort Wingate Depot Activity does not require any emergency remedial actions. There are, however, instances of known or suspected releases of hazardous, or potentially hazardous, materials to the environment at FWDA that require additional investigation or remedial action before the property can be released for unrestricted use.

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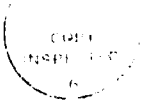


GLOSSARY OF ABBREVIATIONS AND ACRONYMS USED IN THIS WORK

ANL	Argonne National Laboratory
AREEs	areas requiring environmental evaluation
BMTS	Ballistic Missile Test Site
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	cubic feet per second
CPR	cardiopulmonary resuscitation
DDD	dichlorodiphenyl dichloroethane
DDE	dichlorodiphenyl chloroethane
DDT	dichlorodiphenyl trichloroethane
demil	demilitarization (of ammunition)
DRMO	Defense Reutilization and Marketing Office
ft	foot (feet)
ft^2	square foot (feet)
FWDA	Fort Wingate Depot Activity
gal	gallon(s)
gal/yr	gallon(s) per year
gal/day	gallon(s) per day
gal/min	gallon(s) per minute
IRP	Installation Restoration Program
ISC	Information Systems Command
L	liter(s)
MCL	maximum contaminant level
µCi/L	microcurie(s) per liter
µg/L	microgram(s)/liter
mi	mile(s)
mi^2	square mile(s)
mm	millimeter(s)
mg/cm^3	milligram(s)/cubic centimeter
mg/m^3	milligram(s) per cubic meter
mg/kg	milligram(s)/kilogram
mg/L	milligram(s) per liter
mph	miles per hour
MSL	mean sea level

NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NSDWS	National Secondary Drinking Water Standards
OB/OD	open burning/open demolition
PA	preliminary assessment
PCBs	polychlorinated biphenyls
PCDD	polychlorinated dioxins
PCDF	polychlorinated furans
pCi/L	picocurie(s) per liter
POL	petroleum, oils and lubricants
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
RDX	Royal Demolition Explosive - hexohydro-1,3,5-trinitro-1,3,4-triazine
SARA	Superfund Amendments and Reauthorization Act
SWMU	solid waste management unit
TDS	total dissolved solids
TNT	2,4,6-trinitrotoluene
TSCA	Toxic Substance Control Act
USAEHA	U.S. Army Environmental Hygiene Agency
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
UXO	unexploded ordnance

SUMMARY

Argonne National Laboratory (ANL) conducted an enhanced preliminary assessment (PA) of Fort Wingate Depot Activity (FWDA) to assist the Army in implementing the closure of the installation. FWDA occupies about 34 square miles (mi^2) in McKinley County, New Mexico. The closure was directed by the Defense Authorization Amendments and Base Closure and Realignment Act, Public Law 100-526.

The PA concludes that no emergency remedial actions at FWDA are warranted. It was determined, however, that environmental degradation has taken place at FWDA and that remedial actions are necessary because of prior contaminant releases. Additional studies and investigations are also necessary to characterize the effects of suspected releases from FWDA operations prior to transfer of the property for unrestricted use.

An open burning and detonation area for destroying conventional ammunition and burning bulk explosive material exists in the southwestern portion of FWDA. Known releases there have contaminated the soils, and possibly the groundwater, with explosives and metals. The known areas of relatively extensive contamination include:

- Demolition craters and pads
- Burning grounds (the one presently used and the Old Burning Ground)
- Residue piles
- Fenced-Up Horse Valley
- Old (abandoned) Demolition Landfill.

It is recommended that additional investigations be undertaken to support remedial action in these areas.

An impediment to unrestricted use of property in and around the demolition and burning ground area is the presence of unexploded ordnance (UXO). The region, which is fenced, should be cleared of UXO, as should the buffer zones outside the fenced area, prior to release for unrestricted use. This recommended clearance activity encompasses a significant amount of land and represents a substantial clean-up effort.

Another area of known contamination is the Workshop Area. In the past, munitions washout operations and ammunition maintenance have resulted in known soil contamination that might affect the shallow alluvial aquifer. In this area, the TNT Leaching Beds (Bldg. 503) contain explosive-contaminated soils; the Acid Waste Holding Pond (Bldg. 515) contains pesticide- and PCB-contaminated soil; and the Deactivation Furnace (Bldg. 530) area may have soils contaminated with metals, propellents, and explosives. Remedial investigations are recommended for these known soil contami-

nation problems. Other active and abandoned buildings in the Workshop Area should be inspected for potential releases.

Three other facilities in the Workshop Area require further investigation: the pesticide-storage area (Bldg. 537), PCP-treated wooden-box storage areas (Bldgs. 501, 515, and 522), and the current landfill. The PCP-treated wood may contain dioxins and furans, and underlying soils should be tested. The current landfill, while designated for nonhazardous wastes, has operated for several years and is suspected of having received some hazardous materials.

Approximately one-third of the FWDA land area is dedicated to magazine storage of ammunition and explosives. While there is no evidence of substantial releases in any of the individual magazines (including 731 "igloo" units), it is suspected that most magazines contain explosive-contaminated dusts produced over more than 40 years. Appropriate investigations and decontamination of dust-containing magazines in accordance with applicable Army regulations are recommended prior to the release of the igloos and associated properties.

The Administration Area contains a number of known or suspected contributors to soil contamination. Investigations and soil testing are recommended for several facilities, including:

- Storage yard
- Maintenance shops (Bldgs. 5 and 15)
- Locomotive shop
- Fire training area
- Covered POL waste disposal area
- PCB transformer storage areas
- Pesticide storage (Bldg. 29)
- Septic tanks and cesspools
- Sewage treatment plant.

The sewage treatment plant, in the limited access area, contains an unlined settling pond, two unlined evaporation/infiltration ponds, and unlined sludge-drying beds suspected of holding contaminated sediments and soils. No liquid effluent is presently discharged to the surface drainage system from the plant.

Other areas of environmental concern in the installation include:

- Functional test areas
- Pistol range

- Missile test launch sites
- Old (abandoned) Demolition Landfill
- Old Burning Ground.

The functional test areas contain UXO and are suspected of having contaminated soils from munitions impact and burning. The pistol range has operated for a long time and may have contributed lead and powder contamination to the soil. A limited number of test firings of Pershing missiles has left some debris, including two suspected buried missile engines. Soil contamination is suspected at the Old Demolition Landfill and the old trash-burning area (Old Burning Ground).

Soil contamination at several FWDA locations has the potential of migrating via two pathways: surface runoff drainage and percolation to the shallow alluvial groundwater aquifer. The surface water system is primarily ephemeral so that evidence for contamination should be sought among drainage system sediments. The shallow aquifer is discontinuous in both space and time but may have received contaminated infiltration. It should be investigated, particularly in those areas of overlying soil contamination or known infiltration.

There are abandoned and in-service fuel oil storage tanks, both underground and above-ground, that should be investigated for potential contaminant releases. A survey of radon in buildings is underway and should be completed by May 1990. The geologic setting favors the availability of radon and possible contamination. Surveys for asbestos-containing materials and lead-based paint have not been conducted and should be undertaken prior to property transfer or release.

1 INTRODUCTION

In October 1988, Congress passed the Defense Authorization Amendments and Base Closure and Realignment Act, Public Law 100-526. This legislation provided the framework for making decisions regarding military base closures and realignments. The overall objective of the legislation is to close and realign bases so as to maximize savings without impairing the Army's overall military mission. In December 1988, the Defense Secretary's ad hoc Commission on Base Realignment and Closure issued its final report nominating candidate installations. The Commission's recommendations, subsequently approved by Congress, affect 111 Army installations, of which 81 are to be closed. Among the affected installations is the Fort Wingate Depot Activity (FWDA) addressed in this preliminary assessment.[1]

The Commission's summary comments and recommendations with respect to closure of the FWDA and realignment of its major functions are contained in Appendix H of the Commission's final report.[1] The relevant passages are as follows:

> *The Commission recommends Fort Wingate for closure. Its military value is lower than the other installations in the same category, primarily because Fort Wingate is a small, single-mission facility. Its mission can be relocated. The net cost of closure and relocation will be paid back within one year. The Commission expects annual savings to be $5.2 million.*
>
> *Fort Wingate ships, receives, renovates, and stores ammunition and components and is responsible for the disposition of unserviceable ammunition.*
>
> *Sufficient storage capacity is available at other depots to accept the ammunition mission from Fort Wingate. This realignment will eliminate current excess capacity and equipment problems.*
>
> *Closure of Fort Wingate will require the cleanup of environmental hazards before the facility can be considered for unrestricted land use. The major environmental problems are asbestos and contaminated sites. Cleanup of these sites is covered by the Defense Environmental Restoration Program. Cleanup is independent of the closure. Potential issues also exist with the archaeological sites at the installation.*
>
> *The closure will have minimal impact on local employment.*
>
> *The Commission recommends that the activities at Fort Wingate be relocated to Hawthorne Army Ammunition Plant, Nevada.*

Legislative directives require that all base closures and realignments be performed in accordance with applicable provisions of the National Environmental Policy Act (NEPA). As a result, NEPA documentation is being prepared for all properties

scheduled to be closed or realigned. The Base Closure Division of the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) is responsible for supervising the preliminary assessment effort for all affected properties. These USATHAMA assessments will subsequently be incorporated into NEPA documentation being prepared by the Corps of Engineers-Albuquerque for FWDA.

This document is a report of the enhanced preliminary assessment (PA) conducted by Argonne National Laboratory (ANL) under contract to USATHAMA at the Fort Wingate Depot Activity near Gallup, New Mexico.

1.1 AUTHORITY FOR THE PA

The USATHAMA has engaged ANL to support the Base Closure Program by assessing the environmental quality of the installations proposed for closure or realignment. Preliminary assessments are being conducted under the authority of the Defense Department's Installation Restoration Program (IRP); the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 91-510, also known as Superfund; the Superfund Amendments and Reauthorization Act (SARA) of 1986, Public Law 99-499; and the Defense Authorization Amendments and Base Closure and Realignment Act of 1988, Public Law 100-526.

In conducting preliminary assessments, ANL has followed the methodologies and procedures outlined in Phase I of the IRP. Consequently, this PA addresses all documented or suspected incidents of actual or potential release of hazardous or toxic constituents to the environment.

In addition, this PA is "enhanced" to cover topics not normally addressed in a Phase I preliminary assessment. Specifically, this assessment considers and evaluates the following typical issues:

- Status with respect to regulatory compliance,
- Asbestos,
- Polychlorinated biphenyls (PCBs),
- Radon hazards,
- Underground storage tanks,
- Current or potential restrains on facility utilization,
- Environmental issues requiring resolution,
- Health-risk perspectives associated with residential land use, and
- Other environmental concerns that might present impediments to the expeditious "excessing," or transfer and/or release, of federally owned property.

1.2 OBJECTIVES

This enhanced PA is based on existing information from Army records. The PA effort does not include the generation of new data. The objectives of the PA include:

- Identifying and characterizing all areas requiring environmental evaluation (AREEs);
- Identifying property areas or AREEs that may require a site investigation;
- Identifying AREEs or areas of environmental contamination that may require immediate remedial action;
- Identifying other actions that may be necessary to address and resolve all identified environmental problems; and
- Identifying other environmental concerns that may present impediments to the expeditious transfer of this property.

1.3 PROCEDURES

The PA began with a reconnaissance visit by an ANL staff member to the FWDA on October 11, 1989, at which time a briefing was held with the Program Manager and representatives of various facilities operating at FWDA. That briefing served to identify the purpose and scope of the preliminary assessment effort. A brief record search was also made, and a general installation tour conducted. Arrangements were made for interviews, during a subsequent site visit, to be conducted with past and present personnel having knowledge about critical activities occurring on the FWDA. A site visit by several ANL staff members was conducted during the week of October 23, 1989, at which time additional information was gathered through direct observations of critical activities and interviews with appropriate FWDA personnel.[2]

Relevant information from FWDA records and files was obtained during both the reconnaissance trip and the site visit. Photographs were taken at FWDA as a means of further documenting existing conditions at the time of the site visit and are appended.

All available information was evaluated with respect to actual or potential releases to air, soil, and surface and ground waters.

1.4 PA REPORT OUTLINE

Section 2 of this PA report provides a general description of the property from historical and environmental points of view. The section concentrates on the Fort Wingate Depot Activity operations, the environmental setting, and surrounding land use. It includes a summary description of environmental studies at FWDA.

Section 3 identifies all AREEs, both past and current, which are associated with FWDA site. Included in this section are discussions of former operations that could have generated wastes of concern, situations in which hazardous materials were stored at the FWDA site, and spills of such materials that may have occurred in the past. Current waste-management procedures are discussed.

Sections 4, 5, and 6 present the main environmental facts and judgments of this assessment. Section 4 discusses all known or suspected releases to the environment from FWDA site operations and activities. Section 5 provides conclusions regarding current environmental problems and addresses the potential for future impacts to the environment. Section 6 offers recommendations for resolving all outstanding environmental issues associated with this property, identifies actions that will eliminate or reduce the potential for future environmental releases, and recommends additional environmental studies that are warranted or necessary for complete characterizations of known or suspected environmental problems.

Photos of the property and its facilities relevent to the assessment taken by ANL investigators during the site visit are appended.

2 PROPERTY CHARACTERIZATION

2.1 GENERAL PROPERTY INFORMATION

Fort Wingate Depot Activity (FWDA) occupies approximately 34 square miles (mi^2) (22,120 acres) of land in northwestern New Mexico, in McKinley County (Fig. 2.1).[3] The installation is located 8 mi east of Gallup, and about 130 mi west of Albuquerque on Interstate 40. It is bordered on the west by the Zuni Indian Reservation, on the south and east by the Cibola National Forest, and on the north by the Red Rock State Park. Although its history dates back to 1850 (Old Fort Wingate), almost all of the present depot facilities were constructed since 1941.[4]

The installation presently is under the command of Tooele Army Depot, located near Salt Lake City, Utah.[5] Within the FWDA assigned mission, there are three primary functions: (1) to provide facilities for the storage of materiel, namely, ammunition components (explosive and inert), and other commodities (such as equipment and spare parts); (2) to handle the shipping and receiving of materiel, primarily by rail or vehicular transport; and (3) to demilitarize and dispose of obsolete or deteriorated explosives and munitions, rendering them harmless.[6]

In addition to its assigned mission, FWDA hosts, or has hosted, the following tenants: the U.S. Army Reserve (current), the New Mexico Army National Guard (current, once or twice per year), the U.S. Department of Agriculture (current), and the U.S. Department of Energy (recent past). The tenant activities are not directly related to the primary FWDA mission.[6]

The FWDA can be reached by car on Interstate 40, and it is also served by the Atchison, Topeka, and Santa Fe Railroad. Utility services are provided for the depot by various companies serving the city of Gallup and the rest of the area.

2.2 PROPERTY HISTORY

The present FWDA facilities were established primarily in the early 1940s. Prior to that time, some magazine and storage facilities were located at the site; most administrative facilities were east of the present FWDA in the vicinity of the town of Fort Wingate (Fig. 2.1). The present site is only a portion of the site formerly known as "Fort Wingate."

The FWDA is dotted with ruins of prehistoric and historic inhabitation by Indian tribal entities (Fig. 2.2). It has been ascertained that the area hosted Indian peoples since prehistoric times. The site and land in the vicinity have been inhabited for centuries by farming and hunting and gathering Indian tribes, primarily the Pueblo Indians.[7] Two other major tribes, the Navajos and Apache, arrived very late (around 1200 AD) in the area.[7] The Anasazi ("ancient ones," in Navajo language) developed a high state of civilization in the area about 100 BC, a civilization that persisted until 1400 AD.[7] Ruins of Anasazi civilization are found on FWDA (Fig. 2.2).[8]

Today, the Navajo Reservation, which occupies more than 24,000 mi^2 of land (portions of New Mexico, Arizona, and Utah), spreads out to the north of FWDA. On the

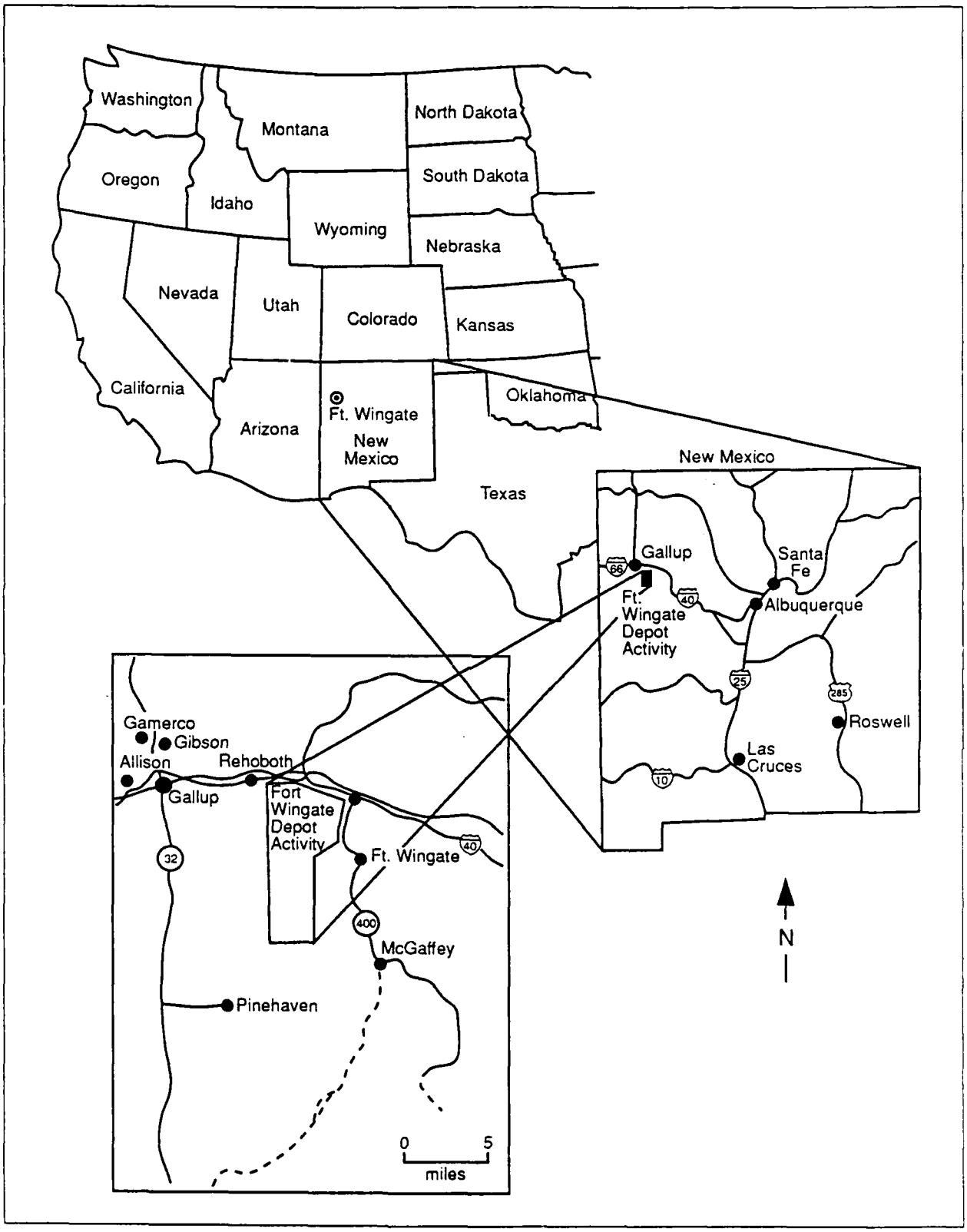


FIGURE 2.1 Location of the FWDA

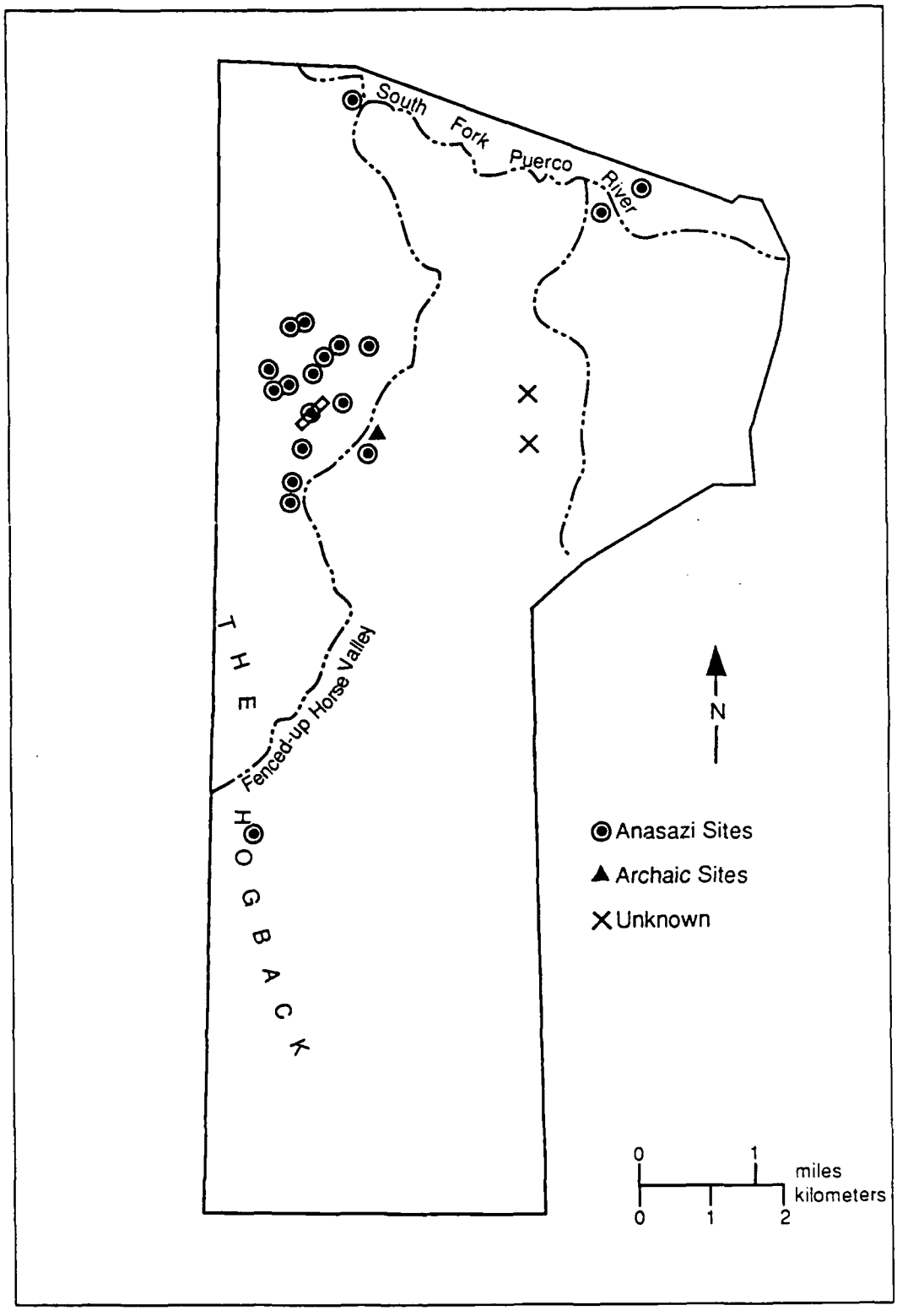


FIGURE 2.2 Prehistoric and Historic Inhabitation Sites of Indian Tribal Entities on FWDA (adapted from Ref. 9)

west side of the FWDA boundary is the Zuni Reservation, which covers part of west central New Mexico. The Zuni origin and history are not known.[7]

Since 1850, the history of Fort Wingate has been tightly woven with the historical events of New Mexico and the U.S. Army. Three locations in New Mexico eventually hosted the fort, and seven names have been used to designate it. Its history is dynamic.

The valley in which FWDA is now located linked old trade routes from the Rio Grande to California.[4] In 1860, the Commander of the Department of Missouri proposed the establishment of a new Army post at Ojo del Oso ("Bear Springs"), on the northern trail to the West. This first post was east of the current FWDA site. It was named Fort Fauntleroy, and later (1861) Fort Lyon.

In 1870, President U.S. Grant announced plans for a 10-mi^2 reservation, and about then plans for the fort were approved and permanent buildings were erected. Meanwhile, the old road to the east through Laguna and Albuquerque was approved. (In 1881, an additional 30 mi^2 to the south were added.[4]) About 1880, Gallup, N.M., began its life as general store and saloon in the middle of rich coal fields; it soon became the trade center nearest Fort Wingate. In 1881, the Atlantic and Pacific Railroad (later the Santa Fe) reached Gallup.[4]

During the second decade of this century, a portion of the Fort Wingate property east of the current FWDA was made into the Zuni District of the Manzano National Forest (now Cibola National Forest, Mt. Taylor Ranger District, Zuni Mountain Range).[4] As World War I (WWI) was ending, the War Department selected Fort Wingate to store munitions. Around 1919, Fort Wingate became the largest installation storing high explosives in the world.[4]

Early in 1941, an extensive rebuilding and construction program started at the site of the present Fort Wingate to meet the needs of shipping foreign aid and supplying armies overseas. At the end of 1941, the administrative buildings and igloo-shaped structures for storing ammunition were finished; all buildings then on the installation were new. At the time of the attack on Pearl Harbor and the entry of United States into World War II (WWII), Fort Wingate became highly active, with more than 1,000 civilians supporting its mission as well as a small number of Army officers.

In 1962, Fort Wingate became a part of the new U.S. Army Supply and Maintenance Command, and in the same year the Army redesignated the depot Fort Wingate Army Depot, although the mission and functions of the installation were not changed.[4] Between 1963 and 1967, Fort Wingate Army Depot was used by White Sands Missile Range to test the mobility and accuracy of firing of the Pershing Missile system.[10] Several missiles were fired from the installation. In 1966, the depot increased its activities by shipping ammunition for the South Vietnam conflict.

In July 1971, the depot was placed in Reserve Status under the command of Pueblo Army Depot (Colorado) and redesignated Fort Wingate Depot Activity.[6] The U.S. Army Materiel Command (in General Order No. 151, dated 18 Sept. 1975) reassigned the Fort Wingate Depot Activity to Tooele Army Depot, Utah.[6]

2.3 DESCRIPTION OF CRITICAL FACILITIES

The FWDA activities and facilities are summarized here, with emphasis on present and past activities and facilities that may be of environmental importance.

2.3.1 Current Organization and Tenants

2.3.1.1 Office of the Commander[10,11]

The Office of the Commander consists of three personnel: the commander, the program manager, and the executive secretary. The office exercises command authority and leadership for the installation and directs and administers the development, execution, and accomplishment of mission operating plans in coordination with the Tooele Army Depot.

2.3.1.2 Mission Division[10,11]

The Mission Division demilitarizes conventional munitions that have become unserviceable. A variety of munitions have been demilitarized, and open burnings of explosives have been conducted by the Division. The Division consists of two branches: the Operations Branch and the Transportation Movement Branch. The Operations Branch conducts inventories and reclaims, preserves, and packages ammunition material.

2.3.1.3 Surveillance Division[10,11]

The Surveillance Division conducts quality control checks throughout the operations activities.

2.3.1.4 Support Division[10,11]

The functions of the Support Division are performed by the Administrative Branch, the Security Branch, the Services Branch, and the Fire Prevention Branch. The Services Branch maintains installation facilities and motor vehicles.

2.3.1.5 Occupational Health Clinic[10,11]

The clinic employs one civilian, an occupational health nurse assigned from White Sands Proving Ground. The primary responsibilities of the clinic are providing emergency first aid and administering the occupational health program for Depot employees. It provides instructional services to Depot employees in preventive medicine, first aid, and cardiopulmonary resuscitation (CPR).

Contaminated materials such as bandages and dressings, used needles, and test tubes are generated by the clinic. Currently, these materials are removed from the site by the nurse, but in the past may have been burned in the incinerator located near the sewage treatment plant or elsewhere on site.

2.3.1.6 U.S. Army Information Systems Command[10,11]

U.S. Army Information Systems Command currently employs two civilian personnel and is responsible for all installation communication systems. It contracts out the telephone systems. Communications personnel also perform minor maintenance on communications equipment.

2.3.1.7 National Guard[10,11]

The New Mexico Army National Guard used to lease 600 acres of land for bivouac and maneuver training. Training occured on one weekend per month. Some firing of weapons took place during this activity. The 1980 lease is up for renewal and may not be renewed.[2]

2.3.1.8 U.S. Department of Energy[10]

The U.S. Department of Energy has had an agreement with FWDA for the storage of instrumentation and equipment associated with atmospheric measurements. The instrumentation and equipment did not contain radioactive or hazardous materials and were stored in magazines not currently used for explosives or munitions. The agreement was recently up for renewal and has not been renewed.[2]

2.3.1.9 U.S. Department of Agriculture[10,11]

The U.S. Department of Agriculture has an agreement with the Department of the Army concerning the use of two warehouse buildings (Bldgs. 12 and 13) at FWDA. The Navajo Tribe has established a food distribution program through which the Department of Agriculture provides surplus food commodities. The FWDA provides the two warehouses for storage of these food stuffs as well as the use of its rail system. The food for the Navajo Tribe in Arizona is shipped from FWDA to four satellite warehouses.

2.3.2 FWDA Facilities

The FWDA installation covers 22,120 acres. The land is used for the administration facilities, workshop activities, magazines, demolition and burning of explosives, and other activities. The open spaces can be characterized as woodland, recreational land, and protection and security buffer zone land. Land use and activity areas, as well as their acreage, are shown in Table 2.1.

TABLE 2.1 Acreage and Percentage of FWDA Land, by Use

Land Use Area	Acreage	% of Total Land
Administration	800	4
Workshop	700	3
Sanitary Landfill	8	<1
Magazine	7,400	33
Demolition and Burning	1,100	5
Woodlands	5,900	27
Recreational	300	1
Protection and Buffer	5,790	26
Miscellaneous	102	<1
TOTAL	22,100	100

Source: Adapted from Ref. 11.

2.3.2.1 Administration Area

The Administration Area and the main entrance to FWDA are located just south of Interstate 40, between the northern boundary of the installation and the Workshop area (Fig. 2.3). It contains administrative office buildings, housing and recreation facilities, general maintenance and warehouse buildings, a clinic, and several utility support facilities. A sewage treatment facility is in an adjacent limited-access area but is grouped with the Administration Area facilities for the purposes of this report. Two warehouses are leased to the Department of Agriculture for food storage and distribution. The principal facilities in the Administration Area are identified in Table 2.2. The activities associated with specific buildings have changed over time.

2.3.2.2 Workshop Area, Ammunition

The Workshop Area, directly south of the Administration Area (Fig. 2.3), is an industrial area containing ammunition maintenance and renovation facilities. The facilities in the Workshop Area for ammunition maintenance, demilitarization, and surveillance are identified in Table 2.3. Many of the facilities are no longer in service, such as the TNT Washout Plant (503) and Deactivation Facility (530) and supporting buildings. Several of these are partially demolished or in disrepair. Others, such as Ammunition Maintenance (528) and Pesticide Storage (537), are in active use.

The current landfill is found just outside of the southwestern corner of the workshop area and is presently designated for nonhazardous solid waste materials (Fig. 2.4).

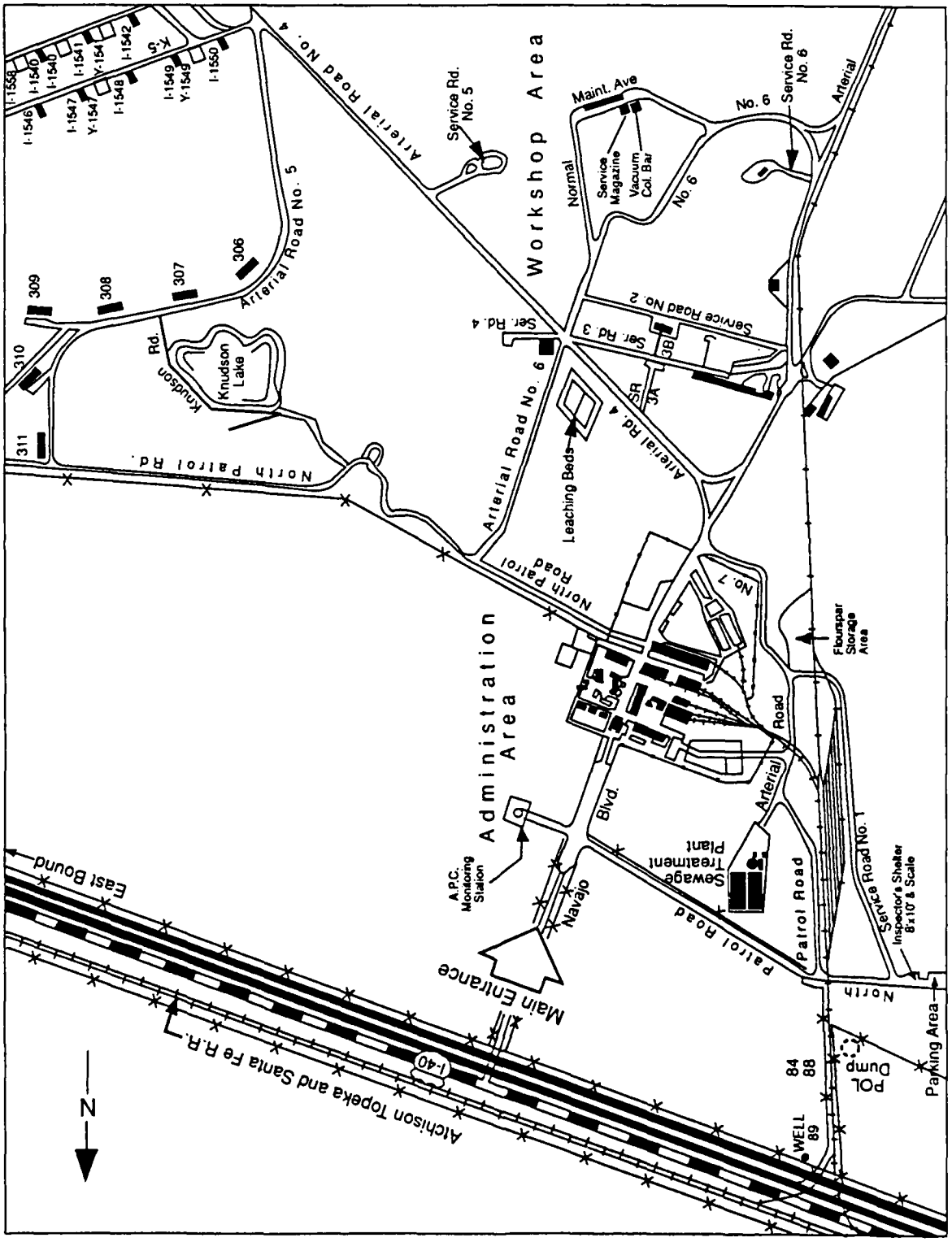


FIGURE 2.3 Administration and Workshop Areas at FWDA (adapted from Ref. 12)

TABLE 2.2 Principal Buildings in Administration Area

Bldg. No.	Activity
1	Administration
2	Water Treatment, Clinic
3,4,28	Living Quarters
5	Vehicle Maintenance
6	Gas Station
7	Paint Storage
8	Paint Shop
9	Allied Trade Shop
10	Salvage, Carpentry (formerly)
11	Locomotive Shop
12,13	Food Storage and Distribution
14	Warehouse
15	Storage, Automotive Maintenance (formerly)
16,26,44	Storage
18	Guard Office
30,31	Billeting Quarters
33	Carpentry
34	Fire Station
36	Heating Plant
61	Water Well House No. 1
63	Sewage Treatment Plant (in limited-access area)

2.3.2.3 Magazine Area

Most of the central portion of FWDA property is occupied by magazine facilities for storing ammunition (shown in Fig. 2.4 as clusters of lined areas). This sprawling area contains 731 earth-covered concrete "igloos" concentrated in 10 clusters (designated A-H, J, and K). The igloo-shaped enclosures are typically about 60 feet deep, with an exposed concrete face and earth-covered sides. They have been used since 1941 for the storage of high-explosive ordnance and other munitions. This area also contains several above-ground ammunition storage structures (standard magazines).

Storage sites for fluorspar are scattered throughout this area. The Magazine Area is served by a network of roads (for trucks) and also by railroads.

2.3.2.4 Demolition and Burning Area[10,13-15]

Between the Magazine and Woodland Areas, and in the west central portion of FWDA, there is a fenced area designated as the Demolition and Burning Area (Fig. 2.4,

TABLE 2.3 Principal Buildings in Workshop Area

Bldg. No.	Activity
501	Boiler Plant
503	TNT Washout
507, 508	Smokeless Powder Magazines
510	Vacuum Producer
515	Clean and Paint
516	Ammunition Receiving
517-521	Disassembly Plant
527	Heating Plant
528	Ammunition Maintenance
529	Flammable Materials Storehouse
530	Deactivation Facility
535	Heating Plant
536	Inspectors Workshop
537	Field Battery, Pesticide Storage
539	Change House, Laundry
541	Heating Plant
542	Ammunition Workshop

Area #10). This large area contains several locations where demolition and open burning of munitions occur. The area also contains disposal grounds for explosive-contaminated material and old equipment from TNT drying and flaking facilities. At least two burning areas, one now closed, are located there. Demolition pits are currently used for demilitarization (demil) operations involving 5,000 lb of explosives above the ground and 10,000 lb of explosives with earth cover. The smaller amounts of explosives are detonated in uncovered areas, the larger ones in earth-covered areas. The western side of the Hogback, in Fenced-Up Horse Valley, contains what appears to be former demolition or burning grounds. The Demolition and Burning Area is described and depicted in greater detail in Sec. 3.4.1 of this report.

2.3.2.5 Other Areas and Facilities

The southern portion of the installation is a Woodland Area (Fig. 2.4), which consists of forested plateau and mountainous terrain. Several roads cross this area. A recreational area, with picnic facilities, is included within the woodland at Lake McFerren. The old Pershing Missile launch site and ballistic missile test launch site are located in this southern portion of FWDA.

A substantial part of the FWDA is designated a Protection Area, consisting of buffer zones that surround the magazine and demolition areas. These zones, or nonused sites, are located adjacent to the eastern, northern, and western boundaries of the installation; they serve also as sites for wildlife habitation.

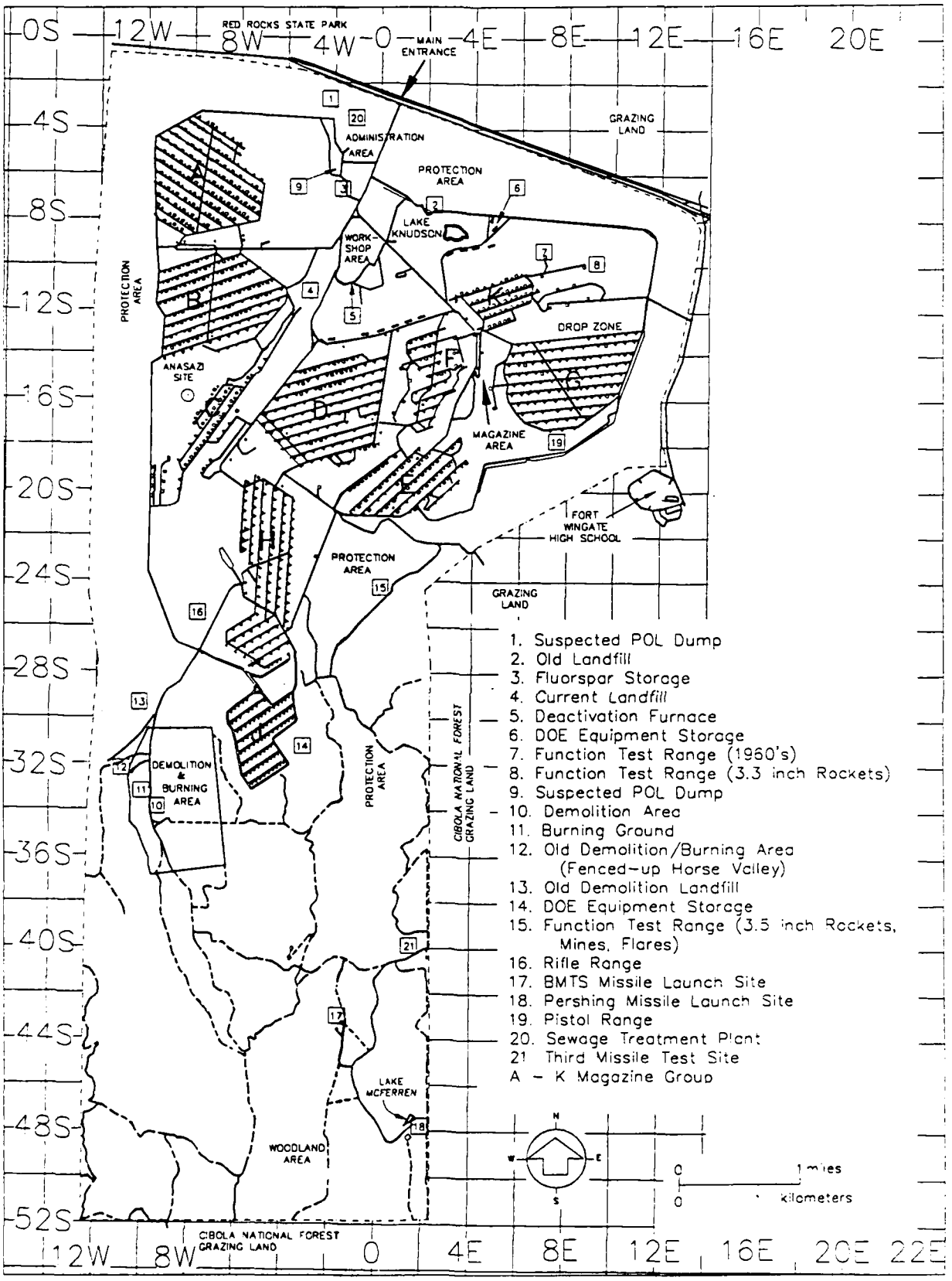


FIGURE 2.4 Magazine Group (10 irregularly shaped clusters, shown as lined areas with letter designations) and Other FWDA Facilities and Sites

Other areas of environmental interest on FWDA land include functional test ranges and suspected old burning grounds. Other small sites also exist, such as land in the southern sector of the property that has been leased by the National Guard for bivouc and maneuver training. Currently, an area in the eastern portion of the site is used as a practice landing area for airborne troops (the drop zone in Fig. 2.4).

2.4 ENVIRONMENTAL SETTING AND SURROUNDING LAND USE

2.4.1 Demography and Land Use

Demographic data pertaining to the FWDA area are depicted in Table 2.4. Within the decade of 1970-80, the City of Gallup grew by 24.4%, while the population of McKinley County increased by 30.6%. Based on University of New Mexico (Bureau of Business and Economic Research) estimates, the county's population will reach 73,000 by 1990 and 91,000 by the year 2000. The population (1980 census) of McKinley County is about 56,000, and that of the town of Gallup is about 18,000.

The most significant economic activity in McKinley County is the retail trade, while the agricultural sector is small. McKinley County's unemployment is reported to be more than 50% higher than that of the state. Less than one third of the county's labor force is employed by the retail sector, and about a third is employed by the public sector (local, state, and federal governments).

The nearest town and trade center to FWDA is the city of Gallup. This community is supported by coal and uranium mining, light manufacturing, freight and passenger railroad activities, as well as tourism and government services. A significant trend in the region's economic activity, until recent years, has been the expansion of coal and

TABLE 2.4 Population Changes in New Mexico, McKinley County, and City of Gallup in 1970-80

	1970	1980	% Change
New Mexico	1,017,055	1,302,894	28.1
McKinley County	43,208	56,449	30.6
Gallup	14,596	18,161	24.4
Remainder of County	28,612	38,288	33.8

Source: U.S. Department of Commerce, Bureau of Census, 1980 Census of Population.

uranium exploration, mining, and milling, while the trade sector is influenced by the Zuni and Navajo reservations, which draw tourists to the county.

Several unique cultural and recreational facilities are located in the area adjacent to the installation. Five Indian reservations, eight national park areas (Navajo, Chaco Canyon, Aztec Ruins, El Moro National Monuments, Mesa Verde, and Petrified Forest National parks, and the Hubbel Trading Post National Historic Site), and three National Forests (Cibola, Carson, and Santa Fe) are in the area surrounding FWDA and the Gallup community.

The FWDA population has varied through the years, from a few thousand to fewer than 100. Currently, the base commander is the only military person assigned to the depot, and fewer than 100 FWDA personnel are civilian employees. Eight persons under contract from Coyote Canyon Rehabilitation Services provide janitorial services.

Transportation facilities for the FWDA are as follows. The main entrance road of the depot connects with Interstate 40 approximately 8 mi east of Gallup. The depot itself contains about 201 mi of internal roads (162 mi surfaced and the rest dirt). There is no bus service between Gallup and the FWDA. The Atchison, Topeka and Santa Fe Railroad serves the major rail needs of the installation, and within the depot are approximately 22 mi of trackage (primarily to the ammunition magazine areas). There is no Army airfield on FWDA. The closest air field to the depot is the Gallup Municipal Airport, about 15 mi away.

McKinley County covers an area of 3.5 million acres. This land is owned by Indian tribes (62%), private parties (17%), the federal government (16%), and the state government (5%). Most of the land is used for grazing of cattle, sheep, and goats. Urban land is limited to the city of Gallup, and military land is restricted to the FWDA. Limited irrigated and dry land farming is practiced by Navajos and Zunis on their tribal lands, where grains, beans, and some vegetables are raised.

The FWDA is almost entirely surrounded by federally owned or administered land, including both national forest and Indian lands. The communities or areas of residential development within the immediate vicinity of FWDA are on Indian lands. McKinley County has not adopted any zoning ordinances and currently has no local zoning authority.

2.4.2 Climate[11]

The area in which the FWDA is located is characterized by an arid to semiarid and cold continental climate. Most of the precipitation occurs in May through October as localized and brief summer storms. Spring and fall droughts characterize the area.

Mean annual rainfall for the area ranges between 10 and 16 in., while the recorded average precipitation during the year for FWDA is 11 in. and fluctuates, between 8 to 20 in., according to local elevations. Most of the precipitation occurs as rain or hail by violent summer thunderstorms, and the remainder is provided by the light winter snow accumulations.

The average seasonal temperatures for the area vary with elevation and topographic features. During winter daily temperatures fluctuate as much as 50 to 70°F in a 24-hour period. In summer daily high temperatures are between 85° to 95°F. Average temperatures in winter are around 27°F and in summer 70°F, while extreme winter temperatures are as low as -30°F and in summer as high as 100°F. The frost-free period ranges between 100 to 150 days during the year and extends from the middle of May to the middle of October.

The area has generally sunny weather, with the sun shining more than 3000 hours annually. Average relative humidity varies from 50% to 15%, respectively, during the wet season (fall) and the dry season (spring). During spring, the area experiences strong winds from west and southwest, with an average wind speed of 12 miles per hour (mph). Strong winds, high temperatures and low relative humidities in the area contribute to high evapotranspiration rates.

2.4.3 Topography[10,16]

Topographically, FWDA property is located primarily in the western part of Fort Wingate Quadrangle and the remainder in the lower southern portion of Church Rock Quadrangle in McKinley County, New Mexico (Fig 2.5).

The northern half of the installation is rather flat with elevations ranging from 6,660 to 6,900 feet (ft) above mean sea level (MSL). This part of FWDA lies mostly in a broad west-to-east trending valley drained by the South Fork of Puerco River. The southern half of the property is characterized by higher elevations, which reach up to approximately 8,200 ft above MSL, and is more steep and vulnerable to erosion. The western and southern boundaries of the installation are marked by the rugged north-to-south trending ridges of the Hogback. Several mountainous terrains, as well as narrow sharp-crested ridges made of steeply inclined and tilted rocks, are striking topographic features of this portion of land.

The topography is furrowed by several intermittent streams of various lengths that run northward and contribute their waters to South Fork of Puerco River. Four small and two large lakes (one mostly dry) exist in the property. Six gravel pits have been observed.

2.4.4 Geology[10,11,16]

The FWDA installation is located in the Navajo section of the Colorado Plateau Physiographic Province and is located on the northern slopes of the Zuni Mountain range. Geologic formations ranging in age from the Permian to Cretaceous are exposed on the FWDA land. The property is situated in an erosional basin that resulted from the uplift of the Zuni Mountain in the south and southeast. During the uplift, the area currently occupied by FWDA was under tensional geological stresses such that extensive fractures developed in bedrocks. Differential erosion formed the basin.

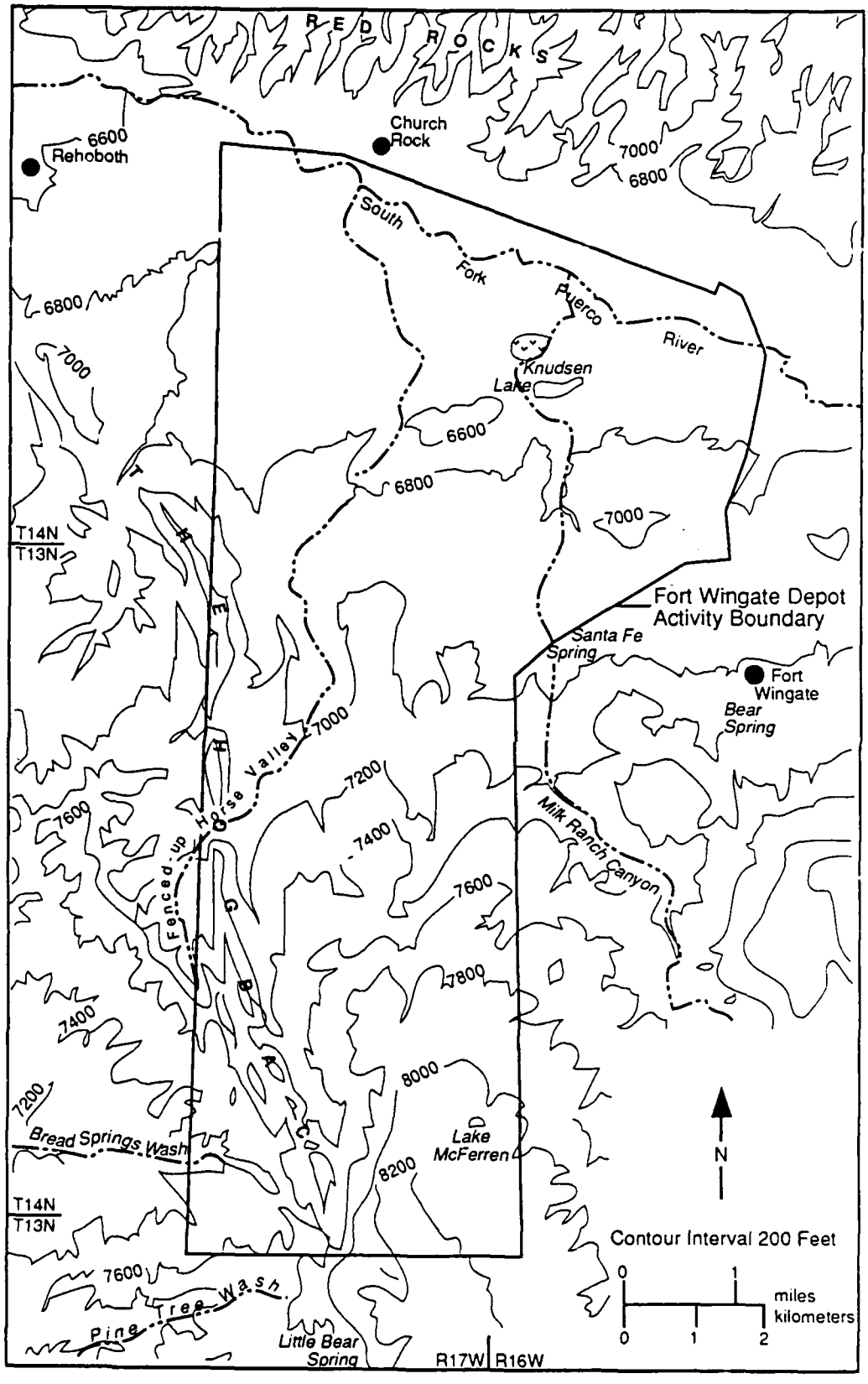


FIGURE 2.5 Topographic Map of FWDA Property (adapted from Ref. 11)

In the southern part of the installation, bedrock of the Permian and Triassic ages dips northward and is exposed on the northern Zuni Mountain slopes that enter FWDA (Fig. 2.6). Near the western boundary, the property is confined by steeply west-dipping bedrocks, forming a hogback topography. The hogback probably represents a monocline structure, the Nutria monocline, which resulted from the draping of the Triassic and older bedrocks over an assumed fault in the Precambrian basement rocks underlying the region.

The oldest bedrocks exposed on FWDA land are Glorieta Sandstone and San Andreas Limestone, of Permian age. They are distributed in the southeastern corner of the installation at an altitude of about 8,100 ft above MSL (Zuni Mountain). The bedrocks dip steeply to the west and to the north beneath younger Triassic strata, in which the two major aquifers of McKinley county are situated.

In the western part of the FWDA property, Mesozoic bedrocks of siltstones, sandstones, and limestones crop out. From top to bottom, these bedrocks are stratified[14] as follows: Menefee Formation (sandstone, claystone, and shale); Crevasse Canyon Formation (Gallup sandstone, shale, and claystone); Mancos Shale; Dakota Sandstone; Morrison Formation (sandstone, and conglomerate); Cow Springs Sandstone; Todilto Limestone; Entrada Sandstone; Wingate Sandstone; Chinle Formation (claystone, siltstone, sandstone, and limestone); and Moenkopi Formation (claystone, siltstone, and sandstone).

The majority of the FWDA area is underlain by the Chinle Formation, of Triassic age. The formation consists primarily of calcareous silty claystone to fine-grained sandstone. Erosion of this formation has resulted in badland (arroyo) topography on slopes. The badland is often capped or interrupted by more resistant sandstones.

Alluvial deposits have been developed along drainage channels and at foothills, as well as at the valley of South-Fork Puerco River north of the Administration Area (Fig. 2.6). The thickness of the deposits varies from zero to 70 ft (at the Administration Area). Thicker deposits are expected along major drainage pathways, which occur in the northern part of the installation. The texture of the deposits has been dictated by the nature of the bedrocks existing in the local area. The deposits are silty and sandy, and their hydraulic permeabilities are moderate.

Although the Cretaceous and Tetriary sandstone deposits in the northwestern area of New Mexico have been found rich in energy resources such as coal, uranium, oil and gas; the only known resources on FWDA land are sand and gravel. This fact, of course, does not preclude the potential identification on FWDA of resources similar to those found in the vicinity.

2.4.5 Soils[10,11,16]

The soils found on the installation are similar to those occurring in cool plateau and mountain regions of New Mexico. The major soil types found in FWDA land are permeable sand and sandy loam clays. All these soils are relatively shallow, and the parent bedrock is either at or near the surface over a quarter of the installation.

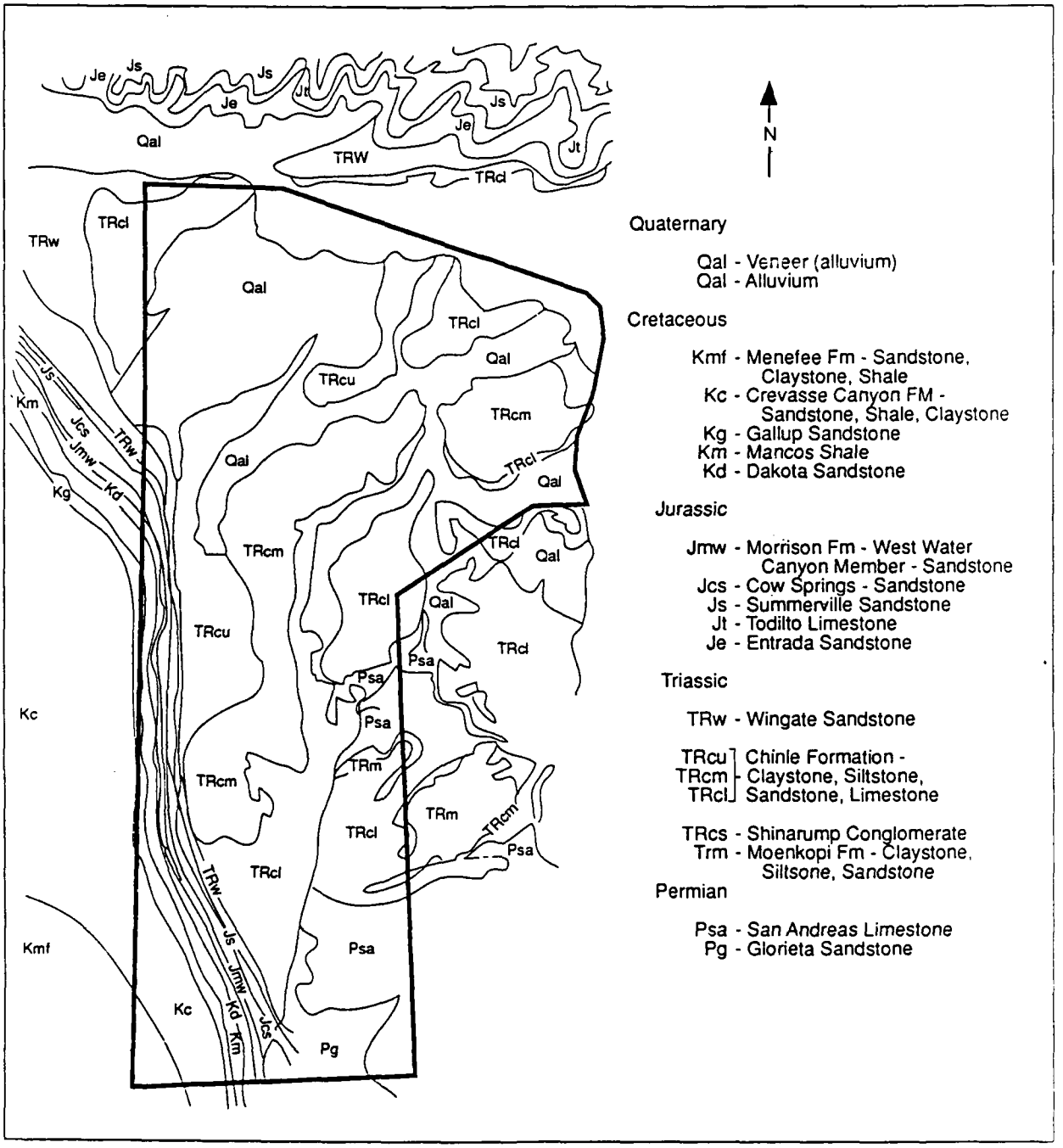


FIGURE 2.6 Geological Formations Found at FWDA (adapted from Refs. 10 and 16)

According to U.S. Soil Conservation Service studies in 1981, four soil units occur on FWDA land: (1) Camborthids-Torriothents soils, which are shallow to deep, loamy, and clayey, which occur on plains hillslopes (slopes of 1-12%), and which occupy approximately the entire northeastern quarter of the installation; (2) Torriothents-Rock Outcrop soils, which are shallow, loamy soils and rock outcrop on the dissected plateaus, escarpments, and hillslopes (slopes of 3-60%) and which occur on the north central-western quarter of the depot; (3) Rock Outcrop-Haplustolls-Argiustolls soils, which are shallow, loamy, and clayey soils, which roll over steep hillsides and canyon walls (slopes of 30-70%), and which are situated in the central (east-to-west) zone, constituting less than half the southern portion of the property; and (4) Eutrobocalfs-Argiborolls soils, which are shallow to moderately deep, loamy and clayey, slightly sloping to steep soils on the mountainous southeastern part of the installation. Figure 2.7 depicts the location and extent of each soil unit on the FWDA land.

The thickness of these soils varies widely over the installation with alluvial accumulations deepest along canyon floors and in the Puerco River valley. Bedrock exposures are common throughout the area to the south. Generally, the soils are loamy, or loamy and clayey, and contain varying amounts of silt, sand, gravel, stones, or rock fragments. All these soils are fragile. Wind and water cause extensive soil erosion, especially where vegetation cover is absent. They are not suitable for dry farming because of several limitations inherent in these soils, such as shallowness, instability, low fertility, and vulnerability to erosion. Strict measures instituted to control and correct erosion have proved to be beneficial. From an agricultural point of view, these soils are more suitable for rangeland exploitation than for any kind of farming. Limited timber production can be also considered on the mountainous parts of the installation.

2.4.6 Surface Waters and Drainage

The drainage systems of the Colorado River and Rio Grande River are separated by the Continental Divide in McKinley County, east of the FWDA. The northwestern part of the county is drained by the upper reaches of the Chico River into the San Juan River Basin, which forms part of the Upper Colorado Basin. The Zuni and Puerco Rivers drain the Lower Colorado Basin through the Little Colorado River. The Rio San Jose and Arroyo Chico drain the southeastern part of the county into the Rio Grande systems.

The Fort Wingate Depot lies in the valley of the South Fork of Puerco River at the foothills of the Zuni Mountain range. The Puerco River, flowing (when water is present) from east to west through the northern portion of the installation, is normally dry. It is fed by many drainage areas originating in the Zuni Mountain range in the southern part of FWDA.

The areas in the vicinity of Interstate 40 from the Continental Divide to the Arizona border are drained by the Puerco River, which flows westerly and intermittently from storm runoff. During the period of heavy uranium mining, from about 1968 to early 1985, the river flowed continuously when mine effluent was pumped into it. Effluent from the city of Gallup wastewater treatment system and discharge from bedrock units also contribute to stream flow between the Gallup and the Arizona state line.

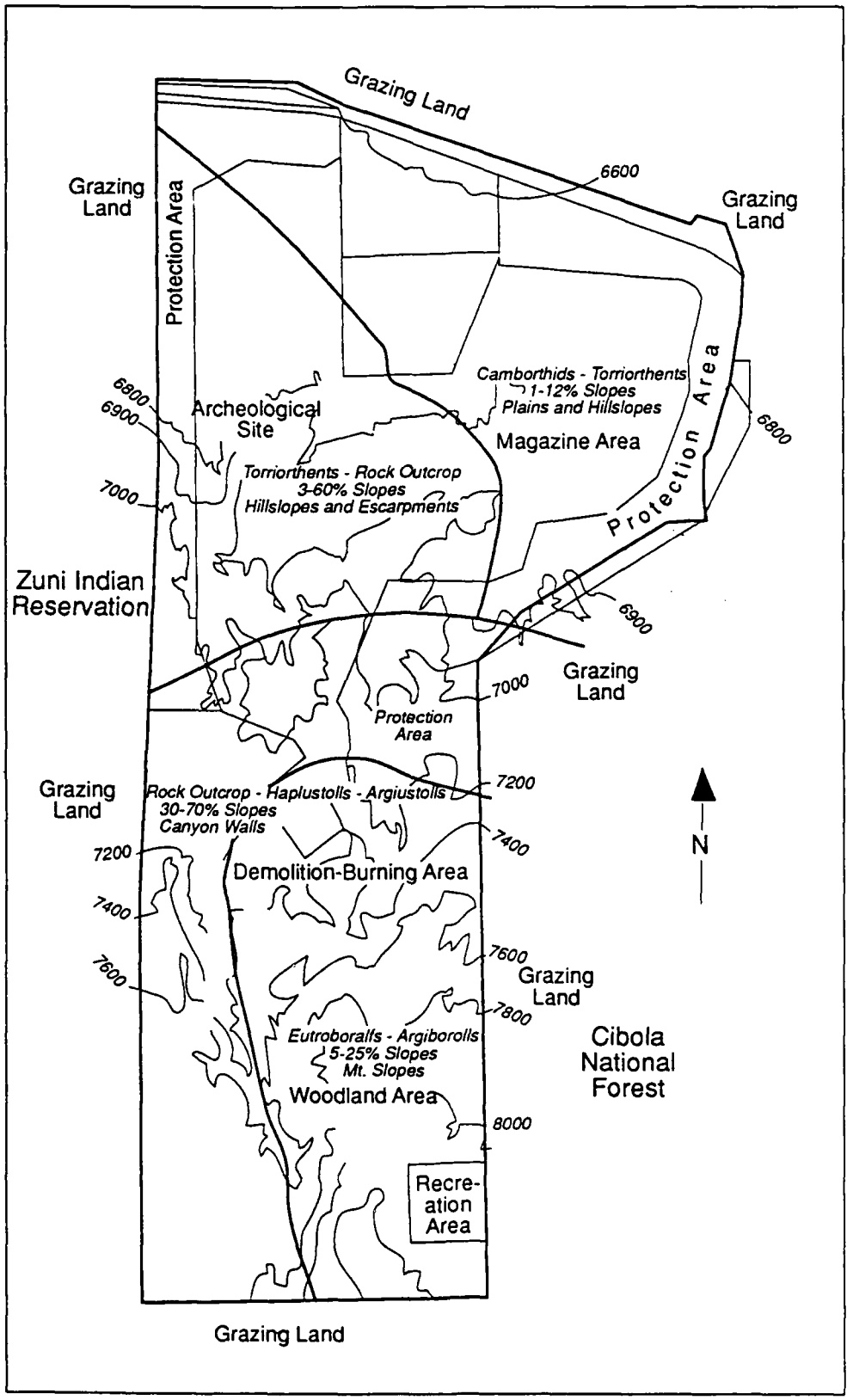


FIGURE 2.7 Soil Units Occurring at FWDA (adapted from Ref. 11)

Natural runoff over erodible uranium-bearing rocks over aeons, 30 yr of mine dewatering discharges, and the shock loading of the tailings spill may have contributed to levels of radioactivity and heavy metals in the Puerco River.

Surface water exists in the FWDA area as the result of spring discharge, and impoundment of surface runoff from rainfall and snowmelt. Spring discharge has been diminished for several years because of the progressive decline of the potentiometric surface in the major aquifer.[11]

There are several different drainage systems in the FWDA (Fig. 2.8). The southeastern corner of the installation is drained to the east by several parallel washes into Milk Ranch Canyon, then northward across the northeast corner of the installation. The central portion of the installation is drained to the northeast along the east side of the magazine storage areas into the lower reaches of Milk Ranch Canyon. A diversion dam channels any flow from the Milk Ranch Canyon drainage system into Knudson Lake. Discharge from Knudson Lake flows into the South Fork of the Puerco River and then west to the Little Colorado River west of Gallup.

The extreme western side of the installation is drained into the Fenced-Up Horse Valley, which drains northward into the Puerco River by means of a network of washes. This drainage system includes the demolition and burning area in the hogback region, the storage areas C, B, and A, the west side of storage areas J and H, and the west side of the Administration Area. Surface runoff from the southwest corner of the installation drains to the west, into Bread Springs Wash, and then into the Puerco River. Surface flow in any of these drainages, except in the upper reaches near spring outfalls, occurs only after heavy rainfall or during snowmelt.[10]

There are two manmade lakes and two ponds in FWDA. The 2-acre McFerren Lake is located near the southeastern boundary in the woodland area. Lake Knudson, a 20-acre shallow intermittent lake, is located in the northern area. A small pond fed by a well and used for watering stock is located on the Eastern Patrol road.

2.4.7 Groundwater and Hydrogeology

Regional groundwater flows from outcrops at elevated areas toward lower outcrop areas in the San Juan Basin. In McKinley County, most of the aquifer recharge by precipitation occurs on the flanks of the Zuni, Chuska, and Cebolleta mountains. Groundwater discharges mainly to the San Juan River tributaries, the Puerco and Zuni rivers, and the Rio Grande tributaries. Ephemeral-stream channels filled with alluvium are principal sources of recharge and discharge for some areas. Unconfined shallow alluvial aquifers in stream channels and valleys are recharged only during periods of surface flow.

Deep groundwater aquifers are generally confined, but interaquifer leakage occurs in the system, in which hydraulic-head differences of 200 ft or more commonly exist. Vertical movement in most areas is greatly inhibited by intervening shale layers. Fracturing in rocks along highly faulted areas may provide permeable hydrologic conduits

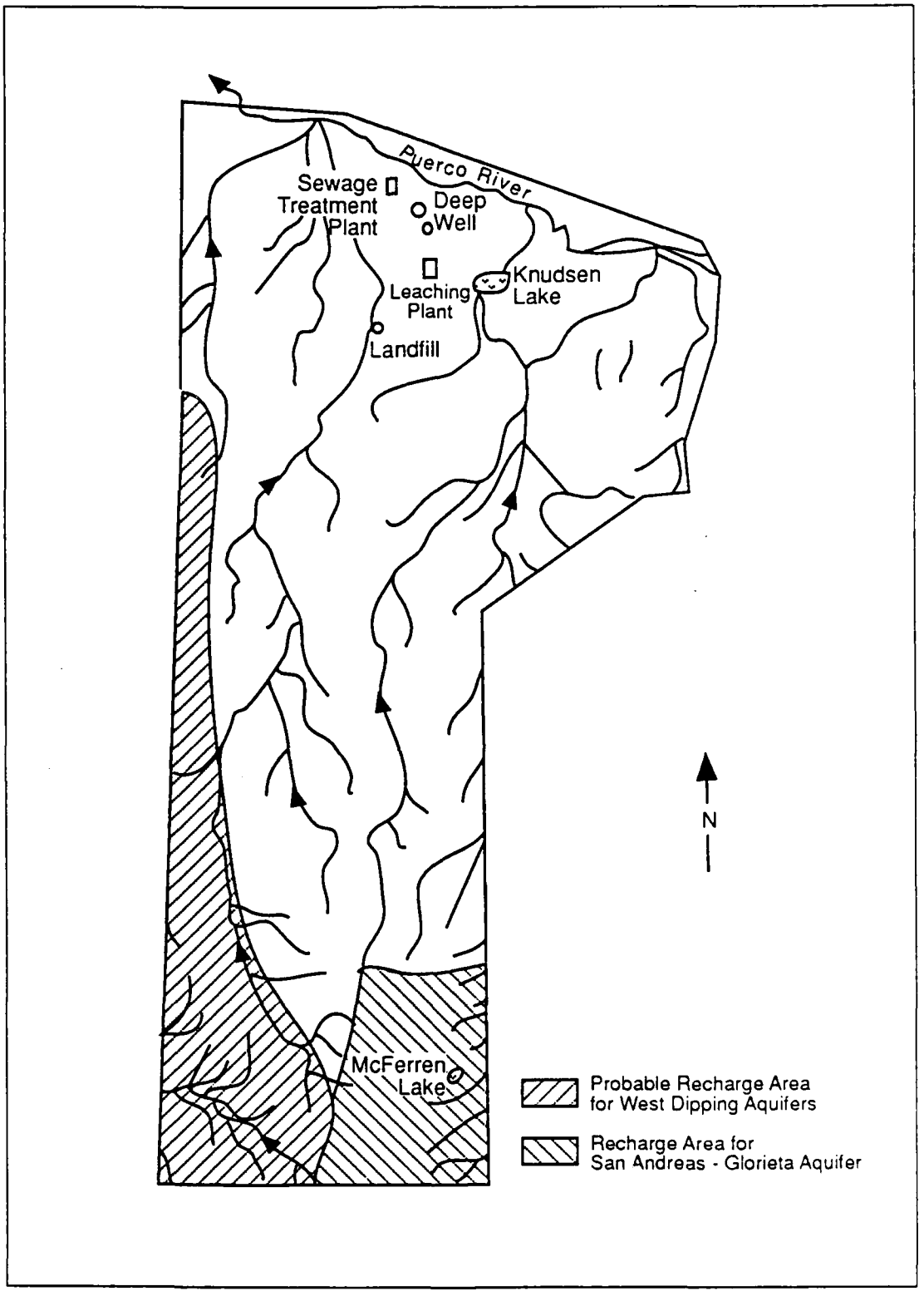


FIGURE 2.8 Surface Water Drainage System at FWDA (adapted from Ref. 16)

for interaquifer flow. These faulted areas occur in the northwest and southeast portions of the San Juan Basin, as well as in association with volcanic dikes and necks.

Late Cretaceous sandstone aquifers occur in the Mesaverde Group and include Dakota and Gallup sandstones, Dalton sandstone of the Crevasse Canyon Formation, Point Lookout sandstone, and coal-bearing Menefee Formation and the Cliff House sandstone. Jurassic aquifers in the area are Entrada sandstone, forming the distinctive red cliffs north of Interstate 40 east of Gallup, and the Westwater Canyon Member of the Morrison Formation. These aquifers form a series of hydraulically interconnected marine and continental sandstones of very fine or medium-grained texture, occurring at depths outside FWDA of from 200 ft to 2000 ft. Yielding at average rates ranging from 50 to 100 gallons per minute (gal/min), developed wells produce water that is fresh near the outcrop areas and for some distance down the flow path.

The region around Gallup, including FWDA, was declared an underground water basin in 1980 by the State of New Mexico. This action prohibits any major new groundwater withdrawals without approval of the State Engineer. The basin covers 1,439 mi^2 and includes the communities of Gallup, Fort Wingate, Gamerco, Mariano Lake, Navajo Wingate Village, and Rehoboth.

Groundwater is present in many rock units underlying the installation. Examination of these rocks and of records of wells in the area indicate that the only formations at FWDA capable of yielding more than a few gallons per minute in a well are the San Andreas Limestone and Glorieta Sandstone of Permian age, and alluvium of Quarternary age. Water-Bearing formations of Jurassic and Cretaceous ages, capable of yielding 100 or more gal/min, are present 4 to 6 mi west of FWDA.

The San Andreas-Glorieta aquifer, which constitutes the primary groundwater source for FWDA, crops out near its southern boundary and dips to the north. The snowmelt probably furnishes much of the recharge water to the aquifer. According to records from the U.S. Weather Bureau, slightly more than 3 in of water are received annually in the area as snow. If it is assumed that 1 in./yr of precipitation infiltrates the groundwater body at FWDA, and that about 2,300 acre/ft per year are obtained for annual recharge. Groundwater flow in the San Andreas-Glorieta aquifer is in a northwesterly direction.

The top of the San Andreas-Glorieta aquifer lies about 1,100 ft below land surface near the Administration Area. Here, the aquifer is about 200 ft thick and under artesian pressure. Local variations in aquifer permeability are large and unpredictable. Currently, one deep artesian well, W2, located at Bldg. 61, meets the installation's demand. This artesian well is 412 meters deep, flows naturally at 2.52 liters per second (L/s), and can be pumped at 15.8 L/s.[10]

Another source of groundwater in the area is the Westwater Canyon Member of the Morrison Formation. This formation could be tapped at a minimum depth of 300 ft in a location approximately 6 mi northwest of FWDA. A well drilled through the Gallup sandstone, the Dakota sandstone, and the Westwater Canyon Member of the Morrison Formation, located approximately four miles west of the installation, would provide a dependable water source. Such a well would have to be about 1,500 ft deep.[11]

Several other younger units associated with the hogbacks, including Entrada sandstone, are also recharged to some extent within the installation boundaries. These strata, dipping steeply to the west, yield very little water within the installation boundaries, but do serve as water sources for much of the area west of the boundary.

The alluvial aquifer, which includes the Puerco River Valley along the northern edge of the installation, is composed of Quarternary system alluvium. These alluvial deposits consist of gravel, sand, silt, and clay derived from rocks of Triassic and Jurassic age that border them. These deposits are primarily recharged from surface runoff, although some deposits in the upper reaches of the installation are recharged by springs from underlying aquifers. Recharge of groundwater flow within the alluvium occurs mainly during the wet portions of the year, specifically with the snow melt in the spring. The groundwater would flow from areas of high elevation, such as the Zuni Mountain at the southern boundary of FWDA, to those of lower elevation such as the Puerco River Valley north of FWDA. The saturated thickness of alluvium aquifer varies greatly. In general, depths to water in the alluvium range from 20 to 30 ft.[10] A well located just north of the installation near Indian Village taps the alluvium aquifer at a depth of 50 ft, where the saturated thickness is 165 ft. This well yields over 100 gal/min and is probably located in the thickest alluvium in the area.

This alluvial basin at the northern edge of the installation has been penetrated by only a few wells.

2.4.8 Water Supply

Groundwater has been the only source of water on FWDA since the 1940s. From 1942 to 1970, the water for FWDA was supplied from a 1125-ft (343-m) deep artesian well located in the administration area.[9] The well tapped the groundwater from the San Andreas-Glorieta aquifer. Originally, the well flowed freely at 300 gal/min and gradually declined to 90 gal/min by 1967. In 1970, in an effort to drill the well deeper, the casing of the well was damaged,[17] and the well was capped. A new well (W2) was drilled to a depth of 1,350 ft, approximately 30 ft m) southwest of the old well in Bldg. 61. The free flow of the new well decreased from 90 gal/min in 1970 to 12 gal/min recently. However, it can be pumped at 165 gal/min.[9]

There are two water supply systems, a potable and a nonpotable, based on the single source at FWDA. Water from the supply well in Bldg. 61 is pumped into a 378,500-L above-ground tank. The nonpotable water, which is used for fire fighting and irrigation, is simply diverted from this tank to a 757,000-L ground storage reservoir, and then to an elevated 946,250-L storage tank. The water is gravity-fed to the rest of the nonpotable water distribution system. The potable water is created by treating water taken from the 378,500-L tank at the water treatment plant in Bldg. 2, where the water is softened by using a sodium zeolite ion exchange process and is chlorinated to a 5 parts per million (ppm) chlorine residual with calcium hydrochlorite. The treated water is then distributed into the potable water system for human consumption and heating plant boilers in the Administration Area.

A separate ion-exchanger in Bldg. 527 used to provide soft potable water for the Workshop Area.[18] The ion-exchanger was reported inoperable in the late 1970s.

According to FWDA personnel, potable water is now brought by pipeline to Bldgs. 528 and 536 from the Administration Area.

Consumption of treated water is approximately 8,000 gal/day, that of untreated water about 23,000 gal/day -- for a total water consumption of 31,000 gal/day. Assuming that the well can be pumped at a rate of 165 gal/min for 16 hours and has a free flow rate of 12 gal/min for 8 hours, the potential yield of the well would be 163,760 gal/day, about 5.2 times current daily consumption.

There are several other wells on the installation.[19] A well drilled in 1950 is located approximately 1 mi southeast of the Administration Area. Because the well yielded inadequate water, it was capped. In 1966, three wells were drilled by the Highway Department during construction of Interstate 40 north of the installation. After the construction of the wells was completed, they were capped and the water right transferred to FWDA. Information on the capacity or water quality of these wells was not available.

Besides the wells mentioned above, there is a spring located in the demolition area. The spring discharge is diverted through a PVC pipe 6 mi long to six storage tanks. The water is primarily for the use of buffalo within FWDA, and its yield is not known.

2.4.9 Water Quality

The limited data on the quality of surface waters on the installation suggest that it is generally good. However, a surface water sample taken from Lake Knudson in 1981 detected excessive chromium in the surface water and oil and grease in the lake sediments.

In general, groundwater from the San Andreas-Glorieta aquifer is of good quality, but it is often high in iron, sulfates, and total dissolved solids. Hardness of water from the San Andreas-Glorieta aquifer ranges from 39 to 1,760 milligrams per liter (mg/L). The hardness apparently does not vary with time in the same well and no consistent geographical variation is known; the variation is probably due to some characteristic of the aquifer rock.

Dissolved solids content of groundwater in the area usually varies. In general, dissolved solid content ranges from 540 to 7,509 mg/L near the recharge area, and as much as 2,400 mg/L in the most distant wells. Sulfate ion concentration also increases with distance from the recharge area. Wells located near recharge areas average approximately 200 mg/L. More distant wells are usually over 500 mg/L. Chloride ion content is highly variable in the area. Chloride concentrations greater than 20 mg/L probably indicate leakage into the well during pumping of water from the overlying Chinle Formation.[11]

The State of New Mexico Health and Environmental Department is responsible for enforcing regulations governing public water supplies. Federal contaminant standards are adapted by the state. Maximum contaminant levels are listed in Table 2.5. Primary

TABLE 2.5 FWDA Raw Water Quality Data, 1970-1988

Parameter	FWDA Raw Water Data[a] (mg/L[b]) 1970	1976	1981	(Oct.) 1988	National Drinking Water Regulations (maximum contaminant level [mg/L[b]]) Primary[c]	Secondary[d]
Alkalinity (g/L $CaCO_3$)	175.0	180	169	174[e]	--	--
Arsenic	--	<0.01	0.018	0.025	0.05	--
Bicarbonate	214	--	--	158	--	--
Cadmium	0	<0.005	0.001	<0.1	0.010	--
Chloride	1.6	5.6	4.0	5.8	--	250
Chromium	--	0.025	0.002	<1	0.05	--
Fluoride	0.2	0.27	0.40	0.25	4.0	2.0
Gross alpha (pCi/L)	--	10.8	10.4 ± 5.9	19	15	--
Gross beta (pCi/L)	--	16.6	13.7 ± 3.2	8	--	--
Hardness (total as $CaCO_3$)	650	620	618	647[e]	--	--
Iron	0.39	1.07	0.096	0.115	--	0.3
Lead	--	0.005	0.01	<10.05	0.05	--
Magnesium	102	71	79	4.1	--	--
Manganese	--	<0.03	0.02	<4.0	--	0.05
Mercury	--	0.0005	<0.0004	<0.2	0.002	--
Nitrate as nitrogen	0	<1.0	<0.2	0.02	10	
pH	7.7	7.6	7.95	8.24	--	6.5-8.5
Silver	--	<0.025	0.02	<0.2	0.05	--
Sodium and potassium	53	61.9	52	346	--	--
Specific conductance (μmho/cm)	1,280	1,314	1,314	1.494	--	--
Sulfate	564	650	585	585	--	250
Tritium (pCi/L)	--	800	<420	--	20,000	--
Total dissolved solids	918	1,079	1,029	1,013	--	500

[a]Refs. 11,20

[b]Unless otherwise indicated.

[c]U.S. Envivionmental Protection Agency, "National Primary Drinking Water Regulations," July 17, 1989.

[d]U.S. EPA, "National Secondary Drinking Water Regulations," Sept. 26,1988.

[e]1987 information.

levels are those which may affect the health of consumers; secondary levels address the aesthetic qualities of drinking water and are guidelines only.

The results of some raw water analysis at FWDA since 1970 are shown in Table 2.5. All parameters have been within applicable standards except for iron, sulfates, and total dissolved solids. Water samples often exceeded the proposed National Secondary Drinking Water Standards (NSDWS) for iron. Excessive iron is common in deep wells and is not a health hazard. It may discolor laundry and plumbing fixtures and impart an objectionable taste and odor to the water. Treatment of excessive iron is normally not warranted. The sulfate and total dissolved solids (TDS) concentrations have exceeded the proposed NSDWS. No health hazards are associated with elevated levels of these parameters, though the water may be aesthetically unpleasant, particularly to people unaccustomed to it. Both sulfates and dissolved solids impart objectionable tastes to water and cause scale buildup in plumbing and hot water heaters. High levels of sulfates may also have a laxative effect on consumers.[11]

High gross alpha radiation level (greater than 18 to 20 picocuries per liter [pCi/L]) was frequently found in the raw water since 1984. The maximum contaminant level (MCL) criteria for the gross alpha is 15 pCi/L. The combined pCi/L of Radium 226 and Radium 228 found in the raw water was 7.9 in the third quarter of FY 86 and 7.1 in the third quarter of FY87, exceeding the MCL criteria of 5 pCi/L.

2.4.10 Biotic Communities and Endangered Species at FWDA

Its location and topography enable the FWDA property to support cold desert and semiarid biotic communities. Of the total land of the installation, 56% is open land, 44% covered with forests. A small acreage is water area, which includes Lake Knudson (currently dry) and Lake McFerren.

The vegetation and fauna of the installation are comprised of four general biotic communities, which are mainly determined by the elevation, climate, and soils. These resident communities are: (1) Great Basin Desert Scrub community, extending along the Puerco River valley (on both sides of Interstate 40) and comprising generally the lower flat areas of the installation; (2) Great Basin Conifer Woodland community, occupying most of the northern half of the FWDA land and thriving mainly in middle elevations; (3) Petran Montane Conifer Forest community, which covers the foothills of Zuni Mountain and lies in most of the southern half of the property; and (d) the Riparian vegetation and fauna which live along water supplied land.[21] Figure 2.9 illustrates the extent of the various biotic communities on the installation.

As a result of the local climate, soil, and elevation changes, a substantial diversity in plant species can be noted on the FWDA land and its vicinity. Generally, the plant species have adapted to the inconsistent precipitation, semiaridity, low air moisture, high evapotranspiration, large diurnal and seasonal temperature fluctuations, and various human and animal interferences of the installation. The various vegetation groups found on the FWDA property support the existence of distinctive animal species and, furthermore, offer habitats to other influent and incursionary animals.

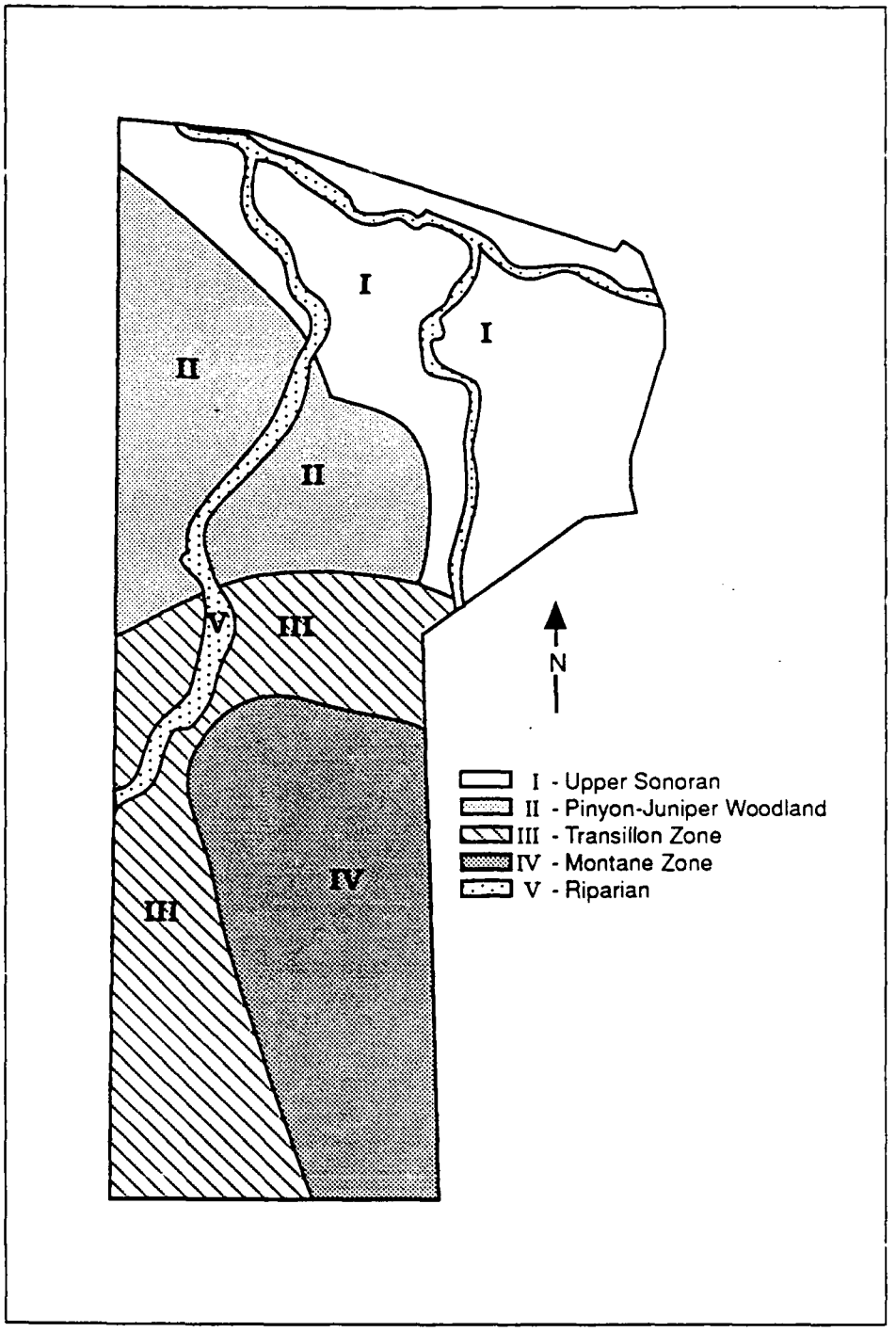


FIGURE 2.9 Biotic Communities at FWDA

The flora of the Desert Scrub community on FWDA land are dominated by sagebrush species, which are joined by other species adapted to the local environment.[22] Species diversity is low, and dominant shrubs in many instances eliminate other woody plants. In general, big and bigelow sagebrushes are mostly found in the deep soil sites of the installation, while black sage brush plants occur on shallow soils. Some of these sagebrushes occur as subdominant in the adjacent conifer woodland. Grasses become essential understory components of this community when the land has not been overgrazed. Otherwise, grasses retreat and sagebrushes extend their dominance. Of the various annual plant species on the installation, several have been introduced; these alien species include Russian thistles, filaree, thumble mustard, and cheatgrass brome. Where grazing and ecological pressures are diminishing on the installation, the alien species have yielded their niches to native plants. Within the Desert Scrub biome (biotic community) on the installation, several other annual and perennial plant species are found growing with representatives of the composite (Compositae) and goosefoot (Chenopodiaceae) families.

A few distinctive animal species are found in the Desert Scrub community of the property like the dark kangaroo mouse, sagebrush vole, and townsend's ground squirrel.[22] Other mammalian species occurring in this community are either indigenous or influent, like coyote and blacktailed jackrabbit. Three birds are characteristic inhabitants in this biome (sage sparrow, sage thrasher, and sage grouse), and there may be more. In addition, many bird species are incursionary or temporary inhabitants. Reptiles are apparently less common than lizards. Reptile representatives found here are gopher snake, wandering garter snake, and two types of rattlesnake.

The Desert Scrub community on the FWDA is continued southward with the Conifer Woodland community of pinyon-juniper dominance.[23] These two short evergreens occur openly in woodland and in less crowded forest. Depending on the location, elevation, and aridity, junipers are more prevalent than pinyons. Utah juniper and Rocky Mountain pinyon appear to be the most common trees in this woodland. Grasses and shrubs compose the understory of the woodland. Big sagebrush dominates other shrubs, which include Mormon-tea, cliffrose, barberry, Apache plume, and other plant species. Several herbaceous representatives can be found in this woodland, including pentestemons, globemallows, and other similar species, as well as grasses such as backwheats, bromes and other monocots. Some cactus species are represented, among them hedgehogs, prickly pears, and chollas.

A few vertebrate species -- such as pinyon mouse and bushy-tailed woodrat, and birds such as pinyon jay, gray fly-catcher, gray vireo, black-throated gray warbler, plateau whiptail, and Scott's oriole -- characteristically reside in this woodland.[23] Many vertebrates from other FWDA communities also occasionally reside in the woodland.

The high elevations of FWDA in the south are covered with the Montane Conifer Forest.[24] The lower limits of this community on the installation are in contact with the pinyon-juniper woodland. Prevailing cold to freezing temperatures before, during, and after winters have caused a few species to dominate the overstory of this forest. The forest is composed of ponderosa pines at lower elevations. Douglas and white firs, with white and limber pines and a few of the quaking aspens, occur at higher elevations. Some Gamble oaks and New Mexico locusts can be found. Ponderosa pines

commercial timber for the installation, but this enterprise has not been exploited methodically. Douglas fir occur mainly in mixed stands with a few other firs, spruces, and pines. Quaking aspen stands host several wild communities, providing food and cover for the animals. Oaks are a very important source of food and habitation for the wildlife on the installation. The understory of the forest is composed of grasses, with a few scattered herbs surrounding a few sparsely grown shrubs including sumac, fendler, creeping mahonia, currents, gooseberries, elderberry, and other species. Montane grasses and sedges include muhlies, bromes, fescues, and a few other plants.

The FWDA Montane Conifer Forest is inhabited by several vertebrate species.[24] Their abundance and distribution is tied with the locale, food and cover availability, climatic conditions, and other ecological factors. Indicative of this biome are the dwarf, vargant, and Merriam shrews, chickaree, Nattal's cottontail, tassel-eared squirrel, porcupine, chipmunks, montane denizens, and bats. Species thriving elsewhere at FWDA can be also found in this forest, such as the spotted ground squirrel, longtail weasel, eastern cottontail, fox, coyote, and mule deer. In addition, many bird species make their homes in this biotic community, including a few owls, broadtailed hummingbird, steller jay, western fly-catcher, goshawk, brown creeper, ladder-backed woodpecker, townsend's solitaire, pygmy nuthatch, and many more birds. Reptiles are limited in species and number.

Riparian flora and fauna on the installation are restricted to areas around lakes and streams, where soil moisture is available most of the year.[25] Lake Knudson in the past has held water the year round, although it has recently become heavily silted and is often dry. It offers watering and nesting to a few water fowls as well as to many migratory and birds flying through. Floral and faunal species requiring aquatic environment can be found in the lake. Other aquatic environments on the installation include Lake McFerren and two other small unnamed lakes that all hold water part of the year. In addition, most streams are intermittent in terms of water flowing and being held; a few of them hold water for a short time during the year. On the banks of the intermittent streams, aquatic and semiaquatic species thrive seasonally.

Several game animals make their home on the FWDA land, including mule deer, buffalo, antelope, desert cottontail, blacktailed jackrabbit, goose, Gambel's quail, and a few waterfowls. Hunting and fishing are restricted to FWDA personnel and their guests within the buffer zone and outside of the highly secured areas of the installation.

Construction activities have disturbed an extensive portion of the biotic communities on FWDA, especially the desert scrub and conifer woodland biomes. Opening and excavation of the land for construction of roads, buildings, magazines (igloos), vehicle parking, fencing, storage, and training facilities, have extensively impacted the communities. Furthermore, FWDA operations have generated various environmental contaminants that may have impacted the biomes.

A cooperative agreement is in practice between New Mexico Game and Fish Commission and FWDA, which concerns the use of previously grazed areas (under lease) for wildlife experimentation (buffalo and antelope) purposes by the Commission. FWDA does not have any other grazing leases.

Among the wildlife inhabitants on FWDA land may be several taxa (species or subspecies) of threatened native species. Most of them have been listed as such because of significant habitat losses and threats in New Mexico. Furthermore, many of these taxa are listed by the federal government as threatened or endangered species. The New Mexico Game and Fish Commission has also developed a list of threatened wildlife species. The list was based on the degree to which habitats or populations are threatened and on probability of extirpation of taxon from New Mexico. Table 2.6 contains the federal and state lists and candidate species for New Mexico. The FWDA area provides habitats to a few such wildlife species, although it is always possible that additional species live temporarily on or cross some of its portions. For example, the bald eagle possibly spends the winter season on land surrounding the lakes.

2.5 ENVIRONMENTAL STUDIES AT FWDA

A record search was conducted in 1980 by USATHAMA to assess the environmental quality of FWDA with regard to the use, storage, treatment, and disposal of toxic and hazardous materials and to define any conditions which may have adversely affected health and welfare or result in environmental degradation.[10] This Installation Assessment (IA) identified areas contaminated with explosive waste in the workshop area, adjacent leaching beds, and demolition/burning ground area. The search also revealed the existence of shrapnel and possibly UXO resulting from disposal operations at the demolition/burning ground area. Although no documentation on contaminant migration was found, the IA suggested that a potential for migration of explosive and chemical waste contaminants existed. A preliminary survey was recommended to assure that wastes generated from past installation operations had not migrated beyond the installation boundaries.

TABLE 2.6 Endangered, Threatened, or Rare Species Possibly Found in Fort Wingate Area

ANIMALS
Bald eagle *(Haliaetus leucocephalus)*
Peregrine falcon *(Falco peregrine)*
Willow flycatcher *(Empidonax traillii)*
Gray vireo *(Vireo vicinior)*
Spotted owl *(Strix occidentalis lucida)*
Spotted bat *(Euderma maculatum)*
PLANTS
Zuni fleabane *(Erigeron rhizomatus)*
Wright's pincushion cactus *(Mammilaria wrightii* var. *wrightii)*
Grama grass cactus *(Toumeya papyracantha)*
Sunflower *(Helianthus paradoxus)*

An environmental survey was performed for USATHAMA in 1981 to determine the extent of contamination caused by activities related to munitions storage, recycling, and treatment.[16] Three groundwater, nine surface water and sediment, and 14 soil sites were sampled and analyzed for nitroaromatics, white phosphorous, priority pollutant metals, organics, pesticides and PCBs, oil and grease, and picric acid. Although only an exploratory sampling effort, this survey produced some preliminary data which revealed that soils and sediments in the immediate vicinity of the Workshop Area and demolition area/burning grounds were contaminated with explosive compounds.

In the Workshop Area, 2,4-dinitrotoluene and RDX were found in a triangle-shaped leaching pit. 1,3,5-trinitrobenzene and 2,4- and 2,6-dinitrotoluene were identified in the leaching beds. Pesticides and PCBs were identified in samples from the current sanitary landfill and from the acid waste holding pond. In the Lake Knudson area, chromium was found in the surface water sample, and the sediment sample contained oil and grease. The groundwater sample contained antimony, as well as elevated levels of nitrate plus nitrite and sulfate.[16]

In the Demolition Area, endosulfan (an insecticide) and Aroclor 1016 (a commercial PCB mixture) were detected in a soil sample from the drywash leading from the Old Burning Ground. High concentrations of explosives -- up to 107 ppm of HMX, 492 ppm of RDX, and 3,180 ppm of 2,4,6-trinitrotoluene (TNT) -- and excessive barium were found in the area. In addition, a sediment sample from the Old Burning Ground contained TNT. High levels of zinc were found in a surface water sample from a metal storage tank in the eastern portion of the demolition area. In the Magazine Area, dieldrin (an insecticide) and Aroclor 1016 were identified in a sediment sample from the D-Area Pond 425.

In this environmental survey, groundwater samples were obtained from only three of the 14 monitoring wells installed in the shallow aquifer. The other wells were dry at the time of sampling. The water table was almost nonexistent in the broad valley areas, in which the Magazine Area, Workshop Area, and Administration Area are located. The study documented the existence of water table only in areas where a surface impoundment is nearby and in the demolition area where the aquifer is fed by precipitation, surface runoff, and infiltration. The observations of this sampling study suggested that the shallow alluvial aquifer at FWDA is discontinuous. The discontinuity was not only spatial but also temporal.

A study was conducted in 1987-1988 by the USAEHA to identify, describe, and evaluate all solid waste management units (SWMUs) on FWDA and to delineate those units requiring further sampling, investigation, or corrective action.[13] Eighteen SWMUs were identified at FWDA. The study concluded that samples collected at the Demolition Area residue piles in the earlier study contained high enough concentrations of explosives and barium to warrant remedial investigation. Explosive compounds previously identified at the Burning Ground, with concentrations up to 765 ppm of HMX, 3110 ppm of RDX, and 2810 ppm of TNT -- and elevated levels of barium in the soil and residue -- resulted in the recommendation for further investigation of explosive contaminants at the Burning Ground to be accomplished within the scope of the RCRA Part B corrective action process. The deactivation furnace, maintenance shop, POL waste storage area, old landfill in the demolition area, and fire training pit have been identified as requiring

sampling to determine whether a release of hazardous constituents from any of them has occurred. Sampling and analysis of Puerco River sediments were recommended to identify the presence of any contaminant migration from any SWMU located in the alluvial basin.

2.6 PERMITTING/LICENSING STATUS

The only "permit" determined to be active currently is permission for open burning. It is an interim permit issued by the State of New Mexico Environmental Improvement Division on the basis of a closure and post-closure plan submitted to the state. A RCRA Part B Permit Application for the open burning and detonation areas has been submitted.[14,15]

3 AREAS REQUIRING ENVIRONMENTAL EVALUATION

Areas requiring environmental evaluation are addressed in terms of the broad geographical and functional categories of Administration, Workshop, Magazine, and Demolition and Burning areas, and other areas and facilities. Some operations, of course, cross these categories. Environmentally significant sites and buildings in each area have been reviewed.

Areas requiring environmental evaluation previously identified as SWMUs by the USAEHA[13] are indicated in this report by the "SWMU F\W-" USAEHA designation.

3.1 ADMINISTRATION AREA (Fig. 3.1)

3.1.1 Storm Water Drainage

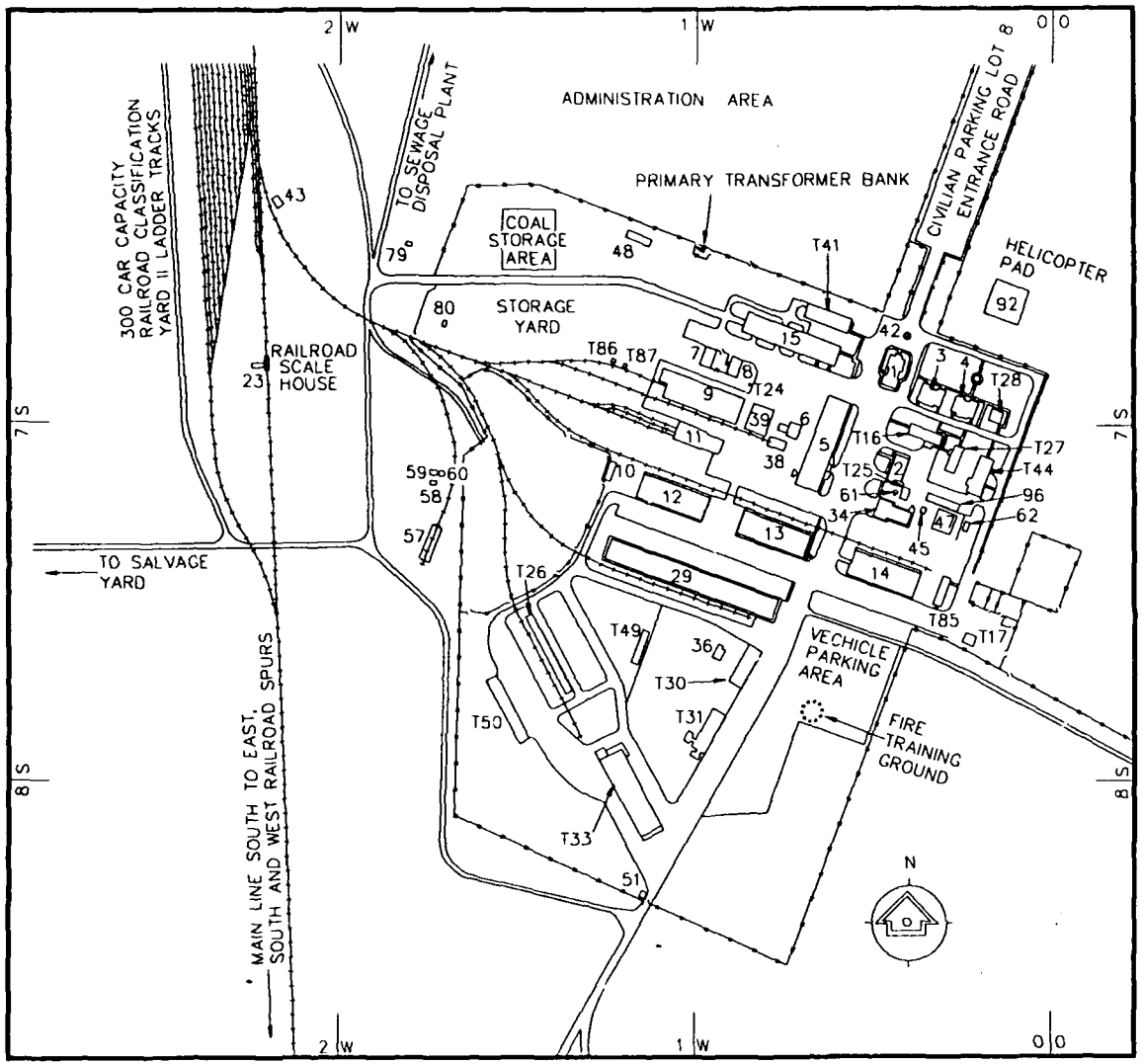
The majority of the installation is drained by a system of culverts, bridges, and drainage channels. The Puerco River is the ultimate receiver of both storm water runoff and sanitary sewage. A storm sewer system serves the administration area and discharges to the open drainage system. Storm runoff containing grease, oils, fertilizer, and solvents is allowed to infiltrate the soils of the area. The system is usually dry except during and after rainfall or snow melt events.

An analysis in 1981 has indicated that a Lake Knudson surface water sample contained 8.9 micrograms per liter (µg/L) chromium.[16] A groundwater sample collected from downgradient of Lake Knudson contained 47 µg/L of antimony. Oil and grease was also detected in the sediment from the lake at 750 mg/kg. A groundwater sample from a well in the workshop area also contained elevated levels of nitrate plus nitrite (8 mg/L as nitrate) and sulfate (2,460 mg/L) relative to the upgradient surface water (nitrate plus nitrite = 0.011 mg/L as nitrate; sulfate = 308 mg/L).[16]

3.1.2 Liquid Waste Collection and Disposal

Only limited industrial activities were performed on FWDA. Hazardous liquid wastes including explosives, leachate, acid, thinners, waste oils and solvents, were generated in bomb washout plant (Bldg. 503), paint shops and vehicle maintenance facilities. [These operations are described separately in Sec. 3.2] Table 3.1 provides a list of past industrial activities on FWDA. Included are the possible contaminants related to each of the listed activities.

Currently, liquid hazardous wastes generated on FWDA are waste oil, solvent, and antifreeze from the vehicle maintenance facility and the locomotive shop. Projected waste oil generation is about 385 gal/yr, while waste solvent is 55 gal/yr (Memorandum of FWDA to Defense Logistic Agency, Defense Reutilization and Marketing Office (DRMO), June 21, 1989). The waste oil is turned into DRMO[3]. The used solvent is picked up by the supplier for recycling/recovery. Waste antifreeze amounting to 220 gal/yr is disposed of through evaporation.



Bldg. No.	Designation
1	Administration Bldg.
2	Family Quarters, Water Treatment Plant & Dispensary
3	Family Quarters
4	Family Quarters
5	Garage, Regimental
6	Motor Fuel Station
7	Paint Storage Warehouse
8	Paint Shop
9	Machine Shop
10	Salvage
11	Locomotive Shop
12	Inert Storage Warehouse (West)
13	Inert Storage Warehouse (Center)
14	Inert Storage Warehouse (East)
15	Garage, now Storage
T-16	Bachelor Officers Quarters
T-17	Horse Stable
23	Railroad Scale House
T-24	Thermometer Shelter
T-25	Officers Garage
T-26	Lumber Shed
T-27	Storage Warehouse
T-28	Family Quarters
29	Inert Storage Warehouse
T-30	Billeting
T-31	Billeting
T-33	Dunnage Shop
34	Post Fire Station
36	Heating Plant, Admin. Area
38	Loading Dock (end)
39	Loading Dock (side)
42	Flag Pole
43	Railroad Tool House
T-44	Storage
45	Water Pump House Admin. Area
47	100 M Gallon Water Storage Tank
48	Heavy Implement Bldg.
T-49	Salvage Shed
T-50	Vacant Lot, formerly Dunnage Reclamation Bldg.
51	Match Guard Bldg.
57	Coal Chute, Bin & Trestle
58	10 M Gallon Road Oil Storage Tank
59	5,500 Gallon Road Oil Storage Tank
60	2,079 Gallon Road Oil Storage Tank
61	Water Well House No. 1
62	Wading Pool
79	Storage Vaults
80	Storage Vaults
T-85	Instruction and Training Bldg.
T-86	Acetylene Storage Bldg.
T-87	Oxygen Storage Bldg

FIGURE 3.1 Facilities within FWDA Administration Area (adapted from an FWDA map)

TABLE 3.1 Industrial Activities at FWDA

Bldg. No.	Activity	Possible Contaminant
5	Arc and acetylene welding, automotive repair, battery charging, cleaning metal parts	Greases, oils, metal dust, stoddard solvent, sulfuric acid
7	Painting, stripping	Alkali strippers, thinners, greases, oils
8	Paint shop, woodworking	Alkali paint strippers, lead paint pigments, thinner
9	Machine shop, blacksmithing, welding, cleaning metal parts, electrical repairing, disposal of fluorescent tubes (under-water in closed box)	Coolants, metal fumes, stoddard solvent, carbon tetrachloride, beryllium phosphors
11	Roundhouse-diesel warmup, steam-cleaning	Solvents, grease, oils, aldehydes, alkali
X-11	Spray painting	Thinner, paint
T15/15	Automotive maintenance, spray painting, battery charging, forging, plumbing and electrical work, roads, and grounds - mixing insecticide and pesticides	Oils, greases, sulfuric acid, stoddard solvent, paint, aldehyde, thinner, carbon tetrachloride, metal and abrasive dusts, metal and flux, Sanfax cleaner (methylene chloride, methyl chloroform, liquid detergent and emulsifier); Malathion; Dieldrin; Chlorane; DDT; Diazinon; Warfarin; Dalapon, Sodium Salt
T-33	Woodworking, paint removal	Paint and abrasive dusts

TABLE 3.1 (Cont'd)

Bldg. No.	Activity	Possible Contaminant
34	Fire station - filling fire extinguishers, machining/ grinding metals	Carbon tetrachloride, metal and abrasive dusts
T-34	Wood shops	--
500	Brush stenciling, removing rusty bomb fins, refusing shells	Solvents, carbon tetrachloride, TNT
501	Boiler plant	Tannin, sodium phosphate dusts
503	Bomb washout, painting shell renovation, cleaning bomb-threads	RDX and TNT, thinner, nitro-glycerine, stoddard solvent
515	Manual sanding; painting, sandblasting, loosening of nuts on bombs (dilute acid and paint wastes drained into a pit located outside of the building), cleaned cartridge cases	Solvents, paint and metallic dusts
527	Boiler plant	Tannin, sodium phosphate
528	Ammo demil, milling and tapping, spray painting, stenciling	Oils, greases, propellants, metal fragments, paint and thinner residues.
536	Inspection of ammo	--
537	Pesticide storage	Chlordane, Malathion, Dieldrin, Diazinon, Chlorpyrifos, Pyrethrin, Calcium Cyanide, Anticoagulant rodenticide bait, propoxur, methyl bromide

Source: Ref. 10.

Domestic sewage in the FWDA Administration area is collected through a sewer network and gravitationally drained to a sewage treatment plant in the northwest of the Administration Area. The sewage receives secondary treatment and is then drained to two evaporation/infiltration ponds. In the other areas of the installation, septic tanks and drainfields were used for sewage disposal.

3.1.3 Maintenance Operations

The two maintenance shops in Bldgs. 5 and 15 are both located in the administration area (Fig. 3.1). In the past, Bldg. 15 (SWMU FTW-8) was used for heavy equipment and automotive maintenance, spray painting, battery charging, plumbing and electrical works, and the mixing of insecticide and pesticides.[10] Since 1980, Bldg. 15 has been reportedly used for general storage and waste oil storage.

Currently, maintenance operations are performed in Bldg. 5. They include battery charging, automotive repair, arc and acetylene welding, and vehicle wash. Soda ash is used to neutralize battery acid in the battery service area inside the building. The neutralized solution is disposed of into a sump which leads to a storm drain. However, this operation has not been authorized under interim status or by a RCRA permit. It was estimated that 5 to 10 truck batteries and one forklift truck battery are serviced each year.[13] The waste mixture of water, oils, and greases from vehicle wash also goes to storm drains. There is no water/oil separator in the building. Detergents were not used.[13]

In March 1987, three air samples were taken in Bldg. 5 for sulfuric acid analysis (Letter of Department of the Army, McAfee U.S. Army Health Clinic to FWDA, 17 March, 1987). All three samples had less than 0.10 milligrams/cubic meter (mg/m^3) concentration of sulfuric acid. The value is below the Federal permissible exposure limit for sulfuric acid of 1.0 mg/m^3.

Waste materiels -- including waste oils, solvents, sulfuric acid, greases, and minor amount of insecticide and pesticides -- were generated in the two buildings. The possible chemicals being used in the past are listed in Table 3.1. In a visit by personnel of New Mexico Health and Environment Department on August 22, 1989,[26] 1,1,1 trichloroethane was identified being used in the past until about in April 1989, when it was then replaced by naphtha.

3.1.4 Material and Coal Storage

The storage yard (SWMU FTW-9) and outdoor coal storage area are located in the northwest part of the administration area (Fig. 3.1) and west of Bldg. 15. They were not active in 1948, but were visible in a 1962 aerial photo.[27] They exist in the same general open area and are separated by less than 50 ft.

The storage yard is currently used primarily to store items being turned in to DRMO or awaiting pickup by a recycling contractor.[13] Items include scrap metals, pipes, radiators, hot water tanks, 55-gal drums of waste oils, solvents, and antifreeze,

empty battery electrolyte containers, and full batteries. When enough waste solvents are accumulated, a recycle contractor is contacted for pickup.

The coal storage area was used to store coal for the power plant on FWDA. Coal was piled on a concrete pad. At the time that ANL personnel visited the site, the coal had been removed.

The storage yard has been used to store hazardous (waste oils, solvents, and batteries) and nonhazardous wastes (scrap metals). In August 1989, the storage yard was noted by the State of New Mexico to have several dozen 55-gal drums of waste oils, solvents, and antifreeze on bare ground or on wooden pallets.[26] Oil-stained soils were found around several drums, indicating spills or leaks. At that time, the solvent drums were reported to have been on site for at least four months, which exceeded the 90-day temporary storage limit allowed by RCRA. When ANL personnel visited the yard, the condition of the drums appeared unchanged. The contents of the drums were reported to have been sampled, but the results of the analyses were not available. Since the visit, installation operations personnel have reported that the waste has been disposed of through Army reclamation channels.

3.1.5 POL Waste Discharge

In interviews with FWDA personnel, an area formerly used as a POL dump was identified. The site is located north of the flurospar storage area in the administration area (72S 2W, Fig. 3.1, and item 9 in Fig. 2.4) and had been used until 1975 for many years. Waste oils and possibly some solvents were disposed of here. When the site was covered with soil in 1975, it was reported that the surface soil on the dump area was saturated with waste oils. Dumping on this site was discontinued at that time. When ANL personnel visited the site in the end of October 1989, no oil-stained soils were visible on the dump site surface.

Another former POL discharge area is reported in previous studies but was not confirmed by FWDA personnel during the interviews. It is suspected to be a mislocation of the only POL dump identified by current FWDA personnel. An environmental assessment report dated 1981[11] described a site location that matches the POL site that ANL personnel visited. However, in that report, the location shown in a figure was different; Item 1, Fig. 2.4 shows it somewhere near the northern boundary of the site. The latter location (SWMU FTW-10) was apparently adopted in another 1988 report.[13] It is unclear that this reported POL dump site represents a different site from that described above.

The POL dump location is further confused by a report dated September 1981.[16] In that report, a monitoring well was indicated as located north of the POL site, but it is shown on a map as south of the known POL dump visited by ANL personnel. This is thought to be another case of mislocation and not another POL dump site.

3.1.6 Septic Tanks and Cesspools

There are three abandoned septic tanks and associated cesspools near the administration area. One septic tank (SWMU FTW-14) is located at the entrance guardhouse, and another is located at the corral immediately east of the administration area.[10] These tanks have been abandoned and there are no plans for future use. Near the tanks, cesspools are shown in some old maps (Wingate Ordnance Depot, General Utilities Map (Sewer), Drawing Numbers WOD 596F, 1965 and WOD 596D, 1954). The cesspool at the entrance guardhouse is rubble lined with a size of 6 ft square by 20 ft deep, and sandy bottom. The cesspool east of the administration building is of rock masonry construction with a diameter of 12 ft and a depth of 12 ft.

The third set of septic tank and cesspool is shown in a safety shelter location plan map (Drawing Number WOD 593, 1953), southwest of Bldg. 542 (designated Bldg. 19 on drawing) The septic tank has a size of 4 ft. by 11 ft, and is connected to a cesspool of 8 ft in diameter and 17 ft deep.

Three active septic tanks/drainfield systems on FWDA provide septic disposal/treatment for isolated areas.[11] They are located at Bldgs. 72, 745 and 746 with 2,000-gal (reported as 192,000-gal, probably incorrectly), 3,000-gal and 2,000-gal capacities, respectively. Flows and loading rates are generally low, allowing drainfields to rest and to minimize failures.

3.1.7 Sewage Treatment Plant

The plant is a secondary sewage treatment plant (SWMU FTW-11) established in 1941. It is located in a limited access area northwest of the Administration Area near the installation northern boundary (Figs. 2.3 and 3.2). The plant includes a bar screen, a lift station, a 192,000-gal/day Imhoff tank, four sludge drying beds, three stabilization lagoons in series, and two evaporation/infiltration ponds. The plant has a designed flow of 124,900 gal/day. The present flow ranges from 3,000 to 5,000 gal/day.[13]

Only domestic sewage was reportedly treated in the plant. The sewage flows in by gravity. The liquid effluent, after a secondary treatment, is evaporated and infiltrated in the evaporation-infiltration ponds. The sludge generated from the Imhoff tank is drained to the sludge drying beds. After the sludge is dry, it is reportedly skimmed off and disposed of in the current landfill.

Except during periods of heavy rainstorms and snow storms, and except for the period between 1975 and 1977, there has been no discharge of treated effluent from the plant. This situation results from the evaporation/infiltration rate of discharge always being higher than the inflow rate. No NPDES permit was acquired except between 1975 and 1977. In that period of time, a water main was broken, apparently resulting in significant infiltration of water into the sewer system. An NPDES permit was obtained[13] to allow discharge of effluent from the plant during that period. The discharge was drained to an open drainage ditch north of the installation, and then to the South Fork of the Puerco River.

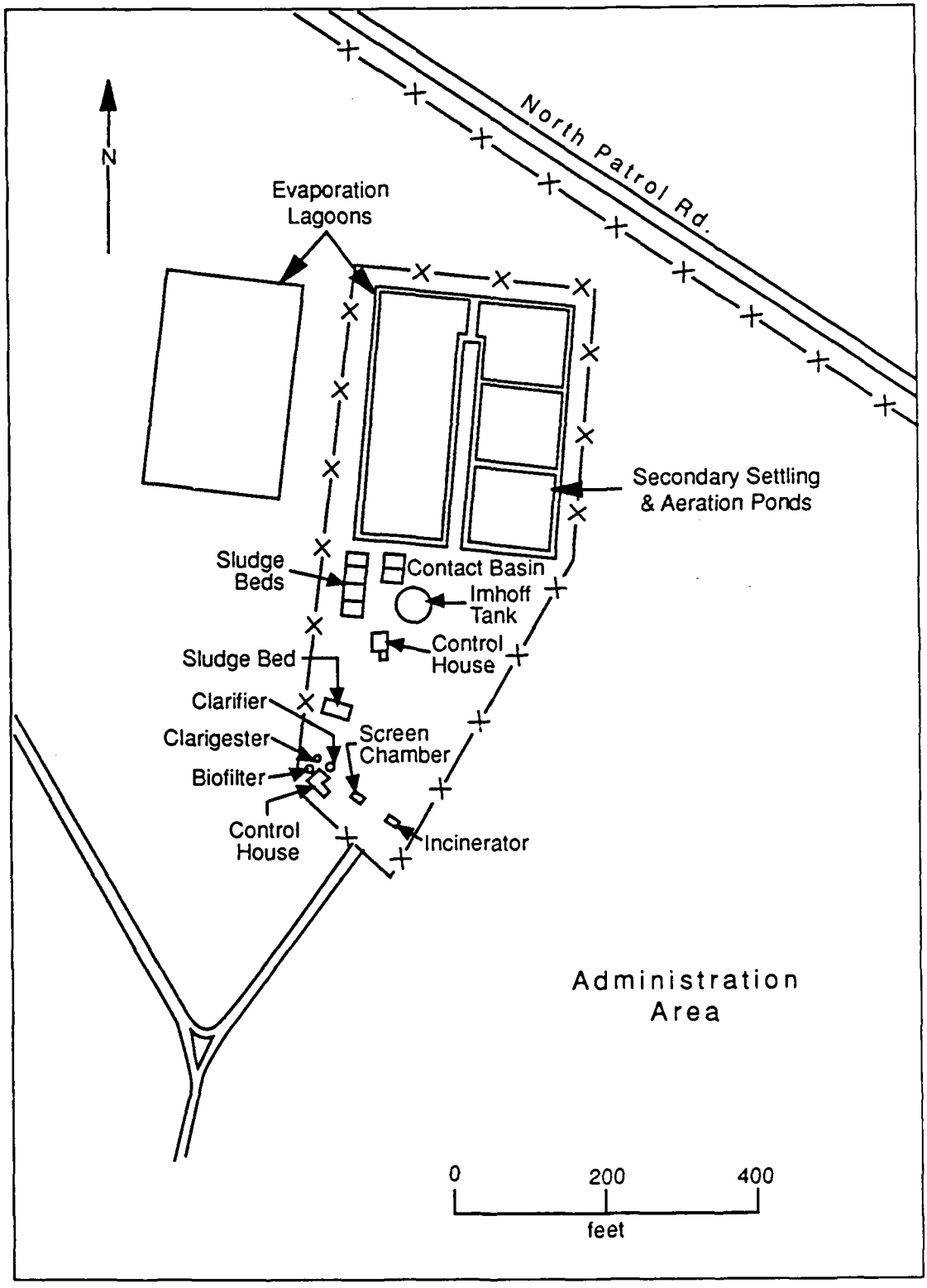


FIGURE 3.2 Location of Sewage Treatment Plant (adapted from Ref. 13)

At the time ANL staff visited FWDA, plant effluent was clear but a pink solution was found in a small, isolated pool in one of the two evaporation/infiltration ponds. Whether the pink solution was effluent or the result of a reaction of the effluent with the soil is not known. According to FWDA personnel, the solution had not been seen in the treatment plant previously.

A small incinerator is located at the treatment plant. The incinerator has reportedly been used for burning classified documents only in the past. It is presently used only for burning classified documents.

3.1.8 Locomotive Shop

The shop (Bldg. 11) is for diesel locomotive maintenance and steam cleaning (Fig. 3.1). The shop has been operative since the 1940s. It has a concrete floor, 3 locomotive maintenance pits, and a drain within each pit. It is not known where the drain discharges.

Lubricated oils, grease, and solvents have been used in the shop. Their quantities are not known. During the ANL visit, one locomotive was present and the maintenance pits were stained with oils. Six 55-gal drums of lubricating oils were stored inside the building.

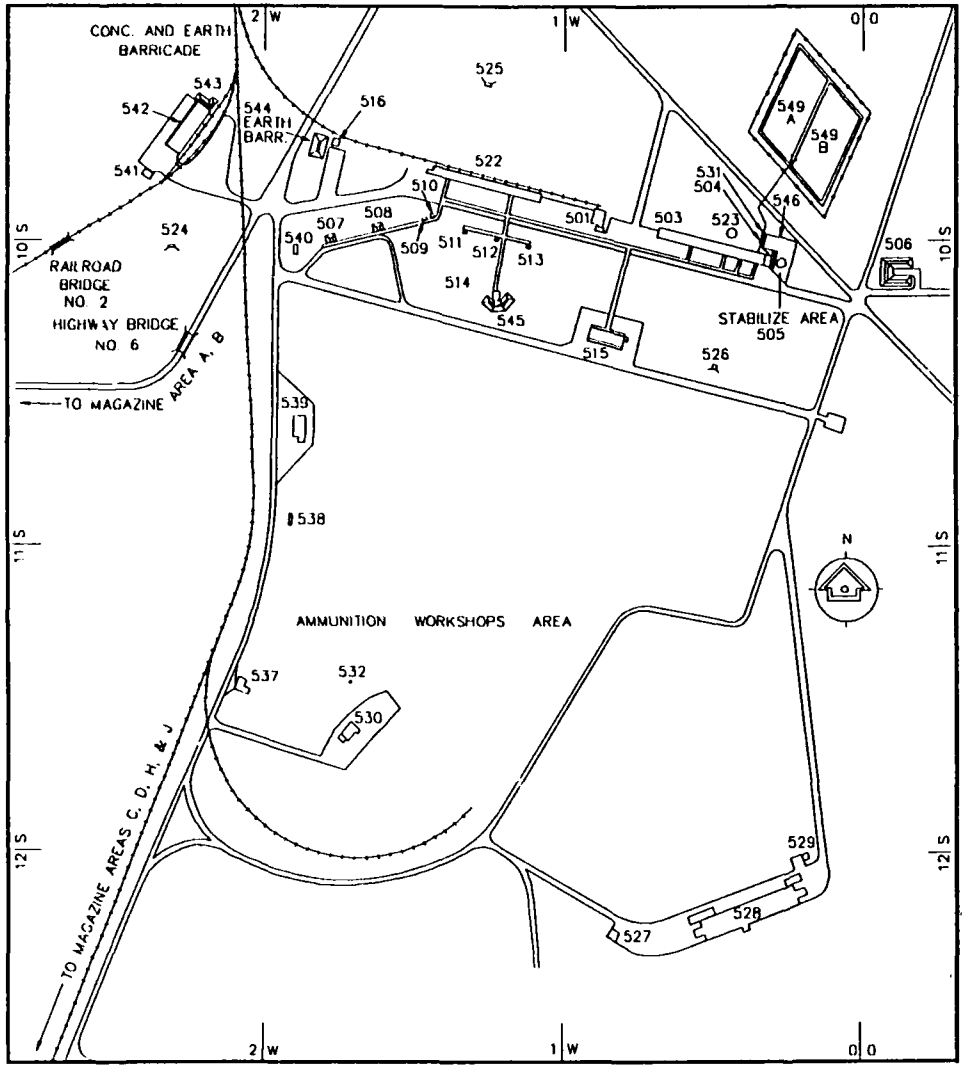
3.1.9 Fire Training Ground

The fire training ground (SWMU FTW-17) is located in the southwest of the administration area (Fig. 3.1). The Bureau of Indian Affairs has had a program to train fire fighters since the early 1970s, reportedly using the pit three times a year. Diesel fuel, organic solvent or oil were dumped onto an unlined pit with a diameter of 20 ft and burned. As much as a 55-gal drum of fuel might be used each time, according to FWDA personnel. Currently, the training ground is not used, but no soil remediation has occurred.

3.2 WORKSHOP AREA, AMMUNITION

3.2.1 TNT Leaching Beds

The TNT leaching beds (SWMU FTW-1) are located in the workshop area (Fig. 3.3) across the road from Bldg. 503. Beginning in 1949, munitions washout operations were conducted in the "500 series" area. Munitions were received in Bldg. 500 where they were unpacked, broken down, and transported to Bldg. 503. There, a hot water washout operation was conducted. The munitions contents (2,4,6-TNT, RDX, Tritonal) were pumped into a storage and drying tank located in the flaker room on the second floor of the building, then flaked, dropped into a hopper in the room below, and boxed and shipped to various Army Ammunition Plants for reuse.



Bldg. No.	Designation
503	TNT Washout Flaker Bldg.
504	TNT Sump Tank
505	1,000 BBL. Water Storage Tank
506	TNT Storage Barricade
507	Smokeless Powder Magazines
508	Smokeless Powder Magazines
509	Primary Collector Barricade
510	Vacuum Producer Bldg.
511	Service Magazines
512	Service Magazines
513	Service Magazines
514	Deboostering Barricade
515	Acid Waste Holding Pond
516	Ammunition Receiving Bldg.
522	Ammunition Renovation Bldg.
523	1,000 BBL. Water Circulating Tank
524	Safety Shelter
525	Safety Shelter
526	Safety Shelter
527	Heating Plant, Ammo. Normal Maint. Bldg.
528	Ammunition Normal Maint. Bldg.
529	Flammable Materials Storehouse
530	Deactivation Bldg. & Barricade
531	Concrete Sump Pit
532	150 Gallon Fuel Storage Tank
537	Field Battery Bldg. (Currently Pesticide Storage)
538	Safety Shelter
539	Workshop Area Change House
540	Safety Shelter
541	Heating Plant, Ammunition
542	Ammunition Workshop
543	Concrete Barricade
546	30 Feet Overhead Crane
549A	Leaching Bed
549B	Leaching Bed
601	Change House and Lunch Room

FIGURE 3.3 Facilities within FWDA Workshop Area (adapted from an FWDA map)

Pinkwater from the TNT washout was disposed of by draining it into three settling tanks outside the building, from which it overflowed into a leaching bed immediately north of the building. In late 1949, approximately 2,400 gallons of water daily were being disposed of in this manner. By 1962, two more leaching beds were constructed and used until 1967, when the operation shut down. The bottom soil of all beds was removed and burned at the old burning ground in the demolition area after shutdown of the operations. This may have caused contamination of the burning ground.

The three beds are located to the northern portion of the Ammunition Workshop Area (Fig. 3.3). One bed is located just north of Bldg. 503 and is shaped like a triangle with the approximate dimensions of 100 ft x 150 ft x 150 ft and is fairly flat. The other two beds are across the road, and each is approximately 250 ft x 150 ft and concave to a depth of 3 ft. Recent analysis indicated low levels of 2,4,6-TNT, RDX, 2,4-dinitratoluene (2,4-DNT) and 1,3,5-trinitrobenzene. Downgradient soil samples contained no contaminants.[16]

3.2.2 Acid Waste Holding Pond

From the late 1940s to the late 1960s, Bldg. 515 housed an ammunition painting facility (Fig. 3.3). Acid tanks were used for pickling surfaces of metal parts prior to painting. The diluted acid wastes from the pickling tanks were routed into an acid waste holding pond west of Bldg. 515. No effort was made to treat or neutralize the spent acid and dissolved metals from pickling and metal cleaning prior to discharge to the holding pond. The pond (SWMU FTW-2) is approximately 20 ft^2 in area and 3 ft in depth.[13] The material in this pond was disposed of by evaporation/ percolation. The waste acid might have been partially neutralized by the alkaline soils. However, acidic and heavy metal contaminants could have infiltrated into the subsurface and a potential exists for contamination of groundwater and soils. During pond overflow, heavy metals might have been transported via surface flow and deposited on the riverbed. A soil sample collected from the acid disposal pit contained excessive concentrations of beta-BHC, chlordane, DDD, DDE, DDT, dieldrin, alpha-endosulfan sulfate, endrin, Aroclor 1260, and PCB.[16] It appeared that the pond has been used for disposing of small quantities of these organic chemicals. Additional sampling of soils was proposed but has not been conducted.[13]

3.2.3 PCB Transformers

A Toxic Substance Control Act (TSCA) non-compliance order was issued for a transformer leaking fluids containing PCBs in 1986 environmental compliance audit report. The transformer was located in the basement of Bldg. 11 (Locomotive Shop; Fig. 3.1); the transformer fluid had been leaking to the concrete floor for several months, and the fluid running off the transformer had not been cleaned up. The building has a floor drain, posing a potential for leaks to migrate to surface water and sediments of the drainage system. The transformer has been replaced by a non-PCB containing transformer, but no sampling or clean-up has been conducted for the PCB spill area in Bldg. 11.

Currently three 41-gal transformers containing fluids with PCBs, located near vault "c" in the north side of Bldg. 2, and two 12-gallon transformers containing fluids with PCBs, located on pole in the northeast side of Bldg. 22, are in service at FWDA. In addition, two inactive transformers containing fluids with PCBs were temporarily stored in a drum packed with absorbent material, in overpack, on the concrete floor in the locked Bldg. 501 (Fig. 3.3) (old steam plant) (SWMU FTW-15) awaiting final disposal.[3]

3.2.4 PCP-Treated Wood Storage

More than 2,000 wooden ammunition boxes possibly treated with pentachlorophenol (PCP) wood preservative have been temporarily stored in the Ammunition Workshop Area (SWMU FTW-16) near Bldgs. 501, 515 and 522 (Fig. 3.3) since 1985. PCP has been shown to contain polychlorinated dibenzo dioxins (PCDDs) and polychlorinated furans (PCDFs), both of which represent a serious environmental threat.[28] Pentachlorophenol is classified by the U.S. EPA as an acutely hazardous substance under RCRA and CERCLA and requires a permit for storage. It is expected that PCP could be relatively mobile in soil-water system due largely to acid behavior and molecular polarity. Therefore, the potential for PCP leaching into the soil exists. However, the limited precipitation at FWDA constrains the amount of PCP leaching expected and would restrict contaminant movement if leaching did occur. The DRMO would not accept PCP-treated wood. As the temporary storage without a permit violates environmental regulations, a proper disposal method is presently being investigated.[13]

3.2.5 Pesticide Storage and Use

Pesticides for insect and rodent control in the buildings and adjacent areas, herbicides for weed control primarily on railroad tracks and along sewage and industrial lines, and fertilizers on lawns and around the Administration Area have been applied for many years on FWDA property by certified personnel. Today, only minor amounts of these materials are stored and used at FWDA.

Prior to use on FWDA property, pesticides are stored in the Pesticide Storage Building (Bldg. 537) (SWMU FTW-18), which is located south of the Workshop Area (Figs. 3.3 and 3.4). The building has a 4,200-square-feet concrete floor area, is well ventilated, and has been used for pesticide storage for many years. All pesticides (mostly insecticides) are stored in leak-proof containers. Approximately 50 gallons of chlordane were stored in this building after this pesticide was no longer used but have since been disposed of.

Herbicides were reported in 1982 to have been stored in leak-proof containers in Bldg. 29,[11] which has a concrete floor and is well ventilated. Currently, herbicides are not stored in Bldg. 29.

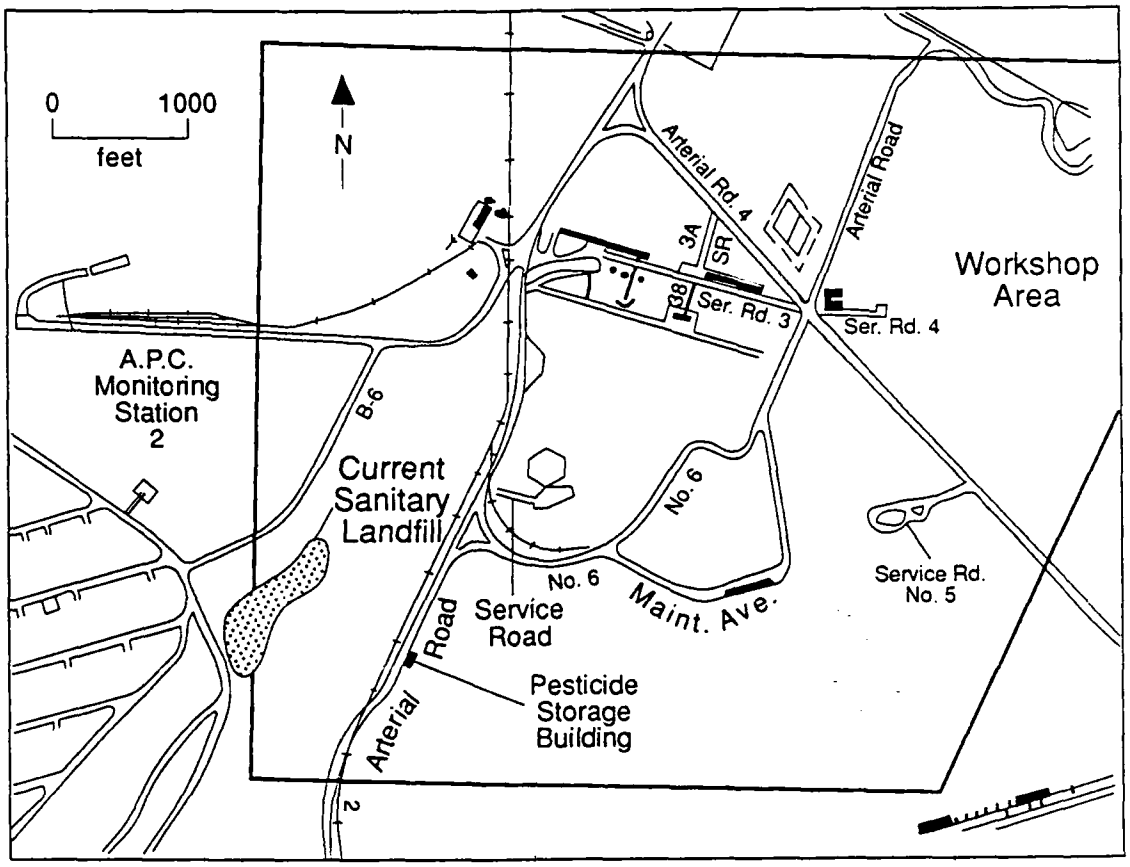


FIGURE 3.4 Location of Pesticide Storage Building and Sanitary Landfill (adapted from an FWDA map)

3.2.6 Deactivation Furnace

The deactivation furnace (SWMU FTW-7) was located in Bldg. 530, in the southern part of the Ammunition Workshops Area (Fig. 3.3). The building covers about 4,000 ft^2. The furnace was used to melt cartridges and small munitions to recover lead, brass, and steel during the late 1950s to late 1960s[3,11]. The status of the furnace operation in the 1960s is not known. From 1976 to 1979, the furnace had very little use.

In 1978, an application was submitted to and approved by the State of New Mexico Environmental Improvement Division for the modification of the deactivation furnace. The facility was to be altered to form a prototype phosphoric acid plant. Elemental phosphorous from white phosphorous munitions would be burned. A hydrator and a wet scrubber system to the furnace exhaust would be added.[11] In 1982, the modified furnace was operated. Later, a conversion of the combustion medium from fuel oil to propane was made. Since then, several design changes were made.[29]

The prototype plant was operated under U.S. Army Armament, Munitions and Chemical Command (AMCCOM). The furnace was capable of demilitarizing white phosphorous munitions ranging from grenades up to and including 155 mm projectiles.[29]

White phosphorous was punched out of the munitions and burned to produce phosphorous pentoxide. It was then passed through a water scrubbing system to produce phosphoric acid. The acid was sold to a commercial carrier to produce fertilizers.

The furnace operation was terminated in or before 1986.[3] It was dismantled by the AMCCOM and disposed of through DRMO after being tested for hazardous wastes.

In November 1980, FWDA applied for a RCRA Part A permit (interim status), in which the deactivation furnace was listed as a treatment facility (incinerator).[30] Since the furnace was converted to manufacture phosphoric acid, no hazardous wastes were considered to be produced.[31]

Currently, all that remains of the furnace room in Bldg. 530 is a concrete floor and a few walls. The control room of the building is left with several opened bags of soda ash which was used to neutralize phosphoric acid. The two acid pits in the southern part of the building are filled with parts of the furnace and covered with gravel.

Two diesel fuel tanks are sitting on the top of a ledge northeast of the building (see Sec. 3.5.3).

3.2.7 Current Landfill

The current Sanitary Landfill (SWMU FTW-6) is located west of the Workshop Area and just east of Storage Area B (Fig. 3.4) and had been operated since 1969. It covers approximately 6 acres and presently is supposed to receive mostly construction and demolition rubble, land debris, paper wastes, and similar material. There is an agreement between FWDA and the City of Gallup whereby all garbage from the the depot, particularly the Administation Area, is collected by the city and hauled to a city-owned landfill for disposal.

In the past, pesticide containers were identified among other waste material disposed in this landfill. A soil sample here in 1981 contained trace amounts of pesticides and Aroclor 1016.[32] The waste and soil cover may be as much as 20 ft deep in portions of the landfill, and the contents of older portions are believed to include garbage from the depot.

At the time of the ANL staff site visit, paint cans and suspected asbestos-containing materials were observed in the active section of the landfill.

3.3 MAGAZINE/IGLOO AREA

Approximately one-third of the FWDA land area is occupied by explosive storage facilities. Some above-ground ammunition storage structures (standard magazines) exist; the majority, however, are earth-covered concrete igloos. The 731 igloos are in 10 groups and distributed from the northwestern corner of the installation to as far south as the Demolition and Burning Area (Figs. 2.4 and 3.5).

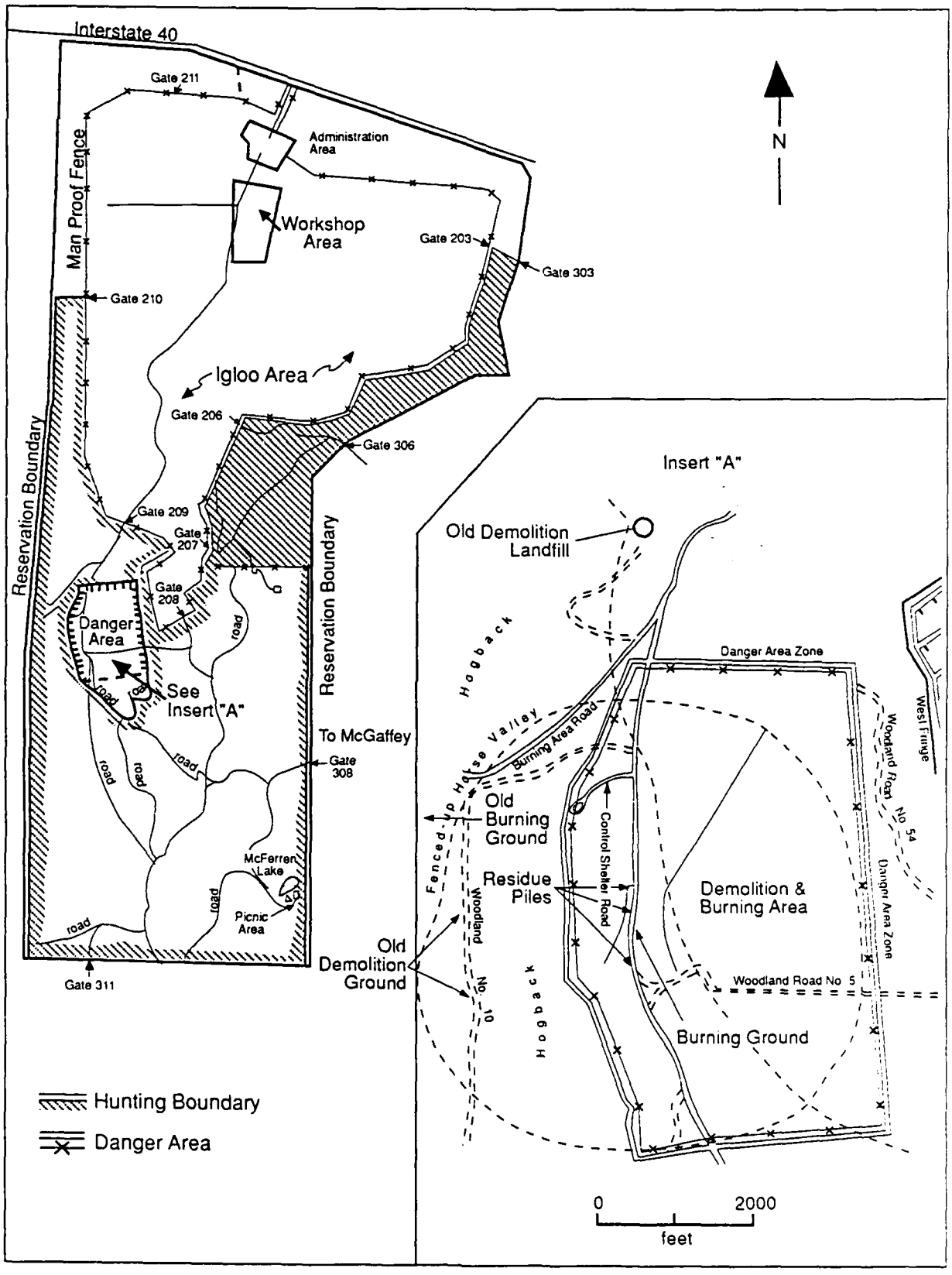


FIGURE 3.5 Demolition, Igloo, and Hunting Areas at FWDA (adapted from Ref. 10)

The igloos have been used for the storage of explosives and ammunition for more than 40 years. No records have been found to suggest that other types of hazardous materials have been stored in these facilities. Two igloos reportedly used by the Atomic Energy Commission in the 1940s were surveyed for radioactivity in 1989, with negative results.[2] Current storage in magazine J309 provided to the Department of Energy is for instruments and equipment and does not include any radioactive materials. Herbicides have been applied around and on the igloos to control weeds.

No record or evidence was found to indicate that any of the individual magazine units had been the site of an explosion or a large accidental release of explosives to the environment. However, over 40 years of use of the igloos have provided the potential for the interiors to contain fugitive dust comprised of explosive materials. While this may not constitute wide spread explosives contamination, individual igloos should be presumed to contain such dust prior to their use for other activities.

3.4 DEMOLITION AND BURNING AREA

3.4.1 Open Burning/Detonation Area

The open burning and detonation area is located in the western section of FWDA (Figs. 2.4 and 3.5). The purpose of this area is the destruction of conventional ammunition and open burning of bulk explosive material. This facility consists of detonation pits, a burning pad area, residue piles (SWMU FTW-5), a landfill, and a suspected old burning/detonation area. It has been in operation for over forty years. but has had a fenced boundary for less than 10 years.

The detonation pits (SWMU FTW-3) are located within the demolition area (Fig. 3.5). In the pits, approximately 4,500 kg of explosives are detonated at one time with sufficient earth cover to contain the force and fragments of the explosion; 2,250 kg of explosives can be detonated without earth cover. Three pits in the northern demolition area, two trenches to the south of the pits, and one trench in the western portion are identified in an aerial photograph from 1948. Three more pits are shown in one from 1962.[32] The detonation procedure follows stringent safety protocols. The entire area is sealed off during planned dentonation events. Currently, one detonation occurs every workday. In the past, however, the rate of detonations was much greater. An application for a RCRA permit for open burning and detonation has been prepared.[14,15] Several types of explosives, propellants, and pyrotechnics have been destroyed there.[3,15]

The current burning pad (SWMU FTW-4) is also located within the demolition area (Fig. 3.5), where open burning of explosive material is conducted. The pad is a metallic trough in which the explosive material is placed and ignited. Strict safety protocols are adhered to when such an open burn is conducted.

As described in Sec. 2.5, soil and sediment samples collected in the Demolition Area Residue Piles were found to contain high concentrations of explosives, up to 107 ppm of HMX, 492 ppm of RDX, and 3,180 ppm of 2,4,6-TNT, and 759 mg/L of barium. The evidence of release of these explosive contaminants warrants remedial investigation.[13] Explosive compounds were also identified at the Burning Ground, with concentrations up to 765 ppm of HMX, 3110 ppm of RDX, 2810 ppm of 2,4,6-TNT, and 735 mg/L of barium. Further investigation for explosive contamination at the Burning Ground was recommended within the scope of the RCRA Part B permit application process.[13] No additional sampling has yet been undertaken.

3.4.2 Explosives Contaminated Landfill

The demolition area has been used as a dumping ground for explosives-contaminated material that had not been decontaminated. Old equipment from the TNT drying and flaking operations was removed from Bldg. 503 during the renovation of the building. This equipment was dumped north of the demolition area in an open landfill (SWMU FTW-13), without being decontaminated or washed. The residues, if any, of materials detonated at the demolition area are left at the demolition site.

3.4.3 Fenced-Up Horse Valley

An old burning ground and/or suspected detonation area exists northwest of the current demolition area in Fenced-Up Horse Valley (Figs. 2.4 and 3.5). This area was listed as being a burning ground that was used from 1948 to 1955, however, visual inspection and information that was reported during the site visit indicate that detonations may have also occurred here. The area contains much shrapnel and is reportedly high in explosive material contamination.

3.4.4 UXO Contamination

Detonation and open burning activities could have significant impacts on surface and subsurface environment in the demolition area and its surroundings. Of course, the unexploded ordnance presents the greatest safety concern and the release of explosives poses the greatest environmental contamination concern. UXO of various types is generated by incomplete detonation and burning and has been found throughout the area. The ordnance is likely to be found in the residue piles as well as burning grounds. Very little information is available in the record to document the amount and location of UXO that has been discovered in the area, and no significant mission-driven attempt has been made to investigate the depth and extent of such ordnance in the subsurface. Incidents of unplanned UXO explosions in this general area were reported to ANL staff by FWDA personnel.

3.5 OTHER AREAS AND FACILITIES

3.5.1 Asbestos

Asbestos containing materials were used in several buildings and for insulating pipes between buildings in the 500 area. The nature of the asbestos used and the extent of the hazard it represents is not known. No asbestos survey has been conducted.

3.5.2 Radon Release

No radon survey of buildings at FWDA has been completed. On-going surveys in the Administration Area should be completed in the next few months.

3.5.3 Underground and Above-Ground Fuel Storage Tanks

According to FWDA personnel, there are six underground fuel storage tanks and six above-ground tanks on FWDA. Their locations and capacities are listed in Table 3.2.

Three of the underground fuel tanks are located in Bldg. 6, a gas station, providing diesel and gasoline fuels for vehicles. Old fuel tanks installed in the early 1940s were replaced in the early 1970s.[33] The other three underground fuel tanks were located in Bldgs. 35, 36, and 536.[11] They were reportedly installed in the 1960s. The fuel tank at Bldg. 35 was used to store kerosene and was reportedly used later for diesel fuel storage. All six underground fuel tanks are still actively used. No leak testing of the fuel tanks were reported.

Among the six above-ground fuel tanks, two asphalt tanks near the old coal field in the Administration Area were installed in the 1950s, and were abandoned in mid-1960s. The two diesel tanks by Bldg. 530 were installed in about 1964. They were used to supply fuel for powering the deactivation furnace in Bldg. 530 and sit idle today. The other two tanks were installed in the 1960s, and are still actively used to store fuel for heating purposes.

3.5.4 Functional Test Area

Three functional test areas exist where various munitions were tested in the past. None is active at present. One is in the northeastern section of FWDA (Site #7 in Fig. 2.4) and is approximately 1 mi x 0.5 mi in size. This area is flat and appears clean; the only visible indications of its former use is a small area at the extreme northeast end and that has noticeably less vegetation than the surrounding areas. This functional test range was reportedly used between 1960 and 1967 to test a variety of rockets including 3.5-in. rockets and 4.2-in. mortar rounds. It is no longer used for any purpose.

TABLE 3.2 Fuel Tanks at FWDA

Description	Capacity (gal)	Location
Underground		
Diesel Fuel	11,760	Bldg. 6
Gasoline	11,760	Bldg. 6
Gasoline	11,760	Bldg. 6
Diesel Fuel	110	Bldg. 35
Diesel Fuel	1,000	Bldg. 36
Diesel Fuel	1,000	Bldg. 536
Above-Ground		
Diesel Fuel	420	Bldg. 11
Diesel Fuel	1,000	Bldg. 530[a]
Diesel Fuel	1,000	Bldg. 530[a]
Diesel Fuel	168	Gate 209
Asphalt	10,000	Near the old coal field in the Administration Area
Asphalt	5,500	Near the old coal field in the Administration Area

[a]The installation reports that this tank has been moved to the Gate 209 area.

The second functional test area is located in the middle-eastern section of FWDA (Site #15 in Fig. 2.4) and is approximately 1 mi^2 in size. This area contains a great deal of shrapnel spread over a large area. This second area was reportedly used in the early 1950s to test mines, flares, signal grenades, and small rockets.[11]

The third functional test range, located near the northeastern boundary of the installation (Site #8 in Fig. 2.4), was used to test high explosives in the 1960s.

UXO contamination is a possibility in the functional test areas.

3.5.5 Missile Launch Sites

Pershing and Sergeant missiles were launched from FWDA as part of a test program in the 1960s. From October 1963 to February 1964, 14 missiles were launched from this area. The three known missile launch sites are all in the southern section of FWDA (Fig. 2.4). Missiles were launched from FWDA into the White Sands Missile Range to the southeast.

The Ballistic Missile Testing Site (Site #17 in Fig. 2.4) contains much debris left over from the launchings including a concrete pad, communication wire, old tires, and two "headstones" that reportedly mark the spot where two missile engines are buried. This BMTS area contains a launch pad and, when operational, contained quarters for the launching team and their equipment.

The Pershing missile site (Site #18 in Fig. 2.4) is located near Lake McFerren. A launching pad is visible, but few other signs remain that this was a missile launch site. This area is currently used for recreation.

A third missile launch site (Site #21 in Fig. 2.4) that was reportedly never used exists to the north of the BMTS and Pershing launch sites, near the eastern border of FWDA. This site has a launch pad, but little other visible evidence that this was a missile launch site.

3.5.6 Training and Range Areas

The New Mexico Army National Guard has leased 600 acres of land for bivouac and tank maneuver training. Training occurred sporadically. Firing of weapons reportedly took place during this activity. The U.S. Army Reserve Engineers also periodically trains personnel on the installation in the use of construction equipment and techniques.

As shown in Fig. 2.4 (Site #19), there is a 25-meter pistol range located 2-1/2 mi to the southeast of the Administration Area. The construction of a new 100-m rifle range located near the southwest boundary of the installation (Site #31 in Fig. 3.1) was completed a few weeks before ANL staff visited the depot. These small-arm training facilities are mainly used by security personnel, police and National Guard.

A drop zone located in the north-eastern portion of the installation (Fig. 2.4) is used for the training of parachute troops. No firing of weapons takes place during training.

3.5.7 Landfilling Operations

Solid waste disposal has been practiced in FWDA over its history in both documented and undocumented places. Today, three landfilling sites are known in the installation, two of which are closed and bear the name Old Landfills (Sites #2 and #13 in Fig. 2.4), and the other is still in operation and called the Sanitary, or Current Landfill (Site #4 in Fig. 2.4). Search of documents indicated that none of the landfill operations in FWDA had been required to have a permit, and thus the closure of the old landfills did not follow the permit formality.

The Old Landfill at Water Tower (SWMU FTW-12) was located on the side of a hill, north of the water storage tank and off North Patrol Road (Site #2, Fig. 2.4). A regular burial of garbage, trash, and debris generated in the depot was conducted in this fill until 1968. Burning may also have been practiced there. It is suspected that

pesticide containers and asbestos containing material have been also disposed here, but probably not explosive-contaminated wastes.

Another closed landfill operation at FWDA was practiced during late 1940s to late 1960s along the embankment of a small arroyo, west of Main Burning Area in the Demolition Area (Fig. 3.5), primarily for debris from demolition and workshop activities as discussed in Sec. 3.4.1.

3.5.8 Old Trash Burning Ground

A map from 1944 identified an area in the northern portion of the installation as a trash burning area. It is located about 2,000 ft west of the sewage disposal plant and south of the road and manproof fence (approximately 3W,5S in Fig. 3.1). The area was not known as a burning ground to present FWDA personnel, but a visual inspection revealed a significant portion upon which no vegetation was found.

4 KNOWN OR SUSPECTED RELEASES

The following discussion focuses on all known or documented and suspected releases of contaminants to the groundwater, surface waters, soils, or atmosphere resulting from activities at the FWDA. For each environmental medium, known or documented releases are presented first, then suspected releases. For the purpose of this section "known" or "documented" releases are those supported by analytical results or by well corroborated observations.

4.1 RELEASES TO GROUNDWATER

The groundwater environment at FWDA is best understood in terms of the "deep" and "shallow" aquifer systems.

The San Andreas-Glorieta aquifer in the northern portion of FWDA is confined by many impervious layers which prevent percolation of contaminants to the deep aquifer. Recharge zones for the deep aquifer are located in the mountainous areas on the southern portion of the installation. Contaminants in this recharge area have the potential to infiltrate into the deep aquifer.

A discontinuous, shallow, unconfined alluvial aquifer exists in the northern portion of the installation. There is a potential for contamination of this alluvial aquifer because of the high permeabilities of the sand, sandy loam, and sandy loam clay soils at FWDA. However, the low rainfall and high evaporation potential tend to reduce the impacts of soil contamination on the alluvial aquifer. The discontinuous nature of the alluvial aquifer may lead to localized contamination.

There are no known releases to groundwater at FWDA.

Suspected releases to the groundwater system result primarily from known and suspected releases to the soils that are thought to have the potential to migrate to groundwater.

Activities in the Demolition and Burning Area are known to have released contaminants to the soil, including explosives, which may have migrated to the deep aquifer. In particular, wastes from the operation of the Deactivation furnace were sent to the burning pit area and provide another source of groundwater contamination.

Several areas requiring environmental evaluation in the Administration Area are suspected of releases to the shallow groundwater aquifer. These include:

- The Fire Training Pit, where organic solvents, diesel fuels, and oils may have been released.
- The old POL dump, containing waste oils, lubricants, and possibly solvents.

- Sewage Treatment Plant ponds, for settling and evaporation/ infiltration, are located on alluvial sands and silts and may have released contaminants.

- Cesspools in the Administration Area may have released contaminants to the alluvial aquifer.

Several areas requiring environmental evaluation in the Ammunition Workshop Area are suspected of releases to the shallow groundwater aquifer. These include:

- The TNT Leaching beds contain explosive contamination, although some contaminated soils have already been removed from them.

- The Acid Waste Holding Pond has the potential of being a source of heavy metal and pesticide inputs to groundwater.

- The acid pits at the Deactivation Furnace could be a source for hazardous material releases to groundwater.

- The current landfill may generate and release leachate that may contain contaminants.

Several areas requiring environmental evaluation in other portions of the installation are suspected of releases to the shallow groundwater aquifer. These include:

- The old closed sanitary landfill probably generates and releases leachate that may contain contaminants.

- The old trash burning area may release contaminants.

- Buried materials at the Functional Test Areas may release explosive contaminants to the groundwater.

4.2 RELEASES TO SURFACE WATERS

Little surface water exists at FWDA except at times of heavy rainfall and snow melt. Contaminants generated and released to the soils from several AREEs could be carried under those conditions via surface runoff, in various drainage routes, to Knudson Lake and the South Fork of the Puerco River. During a period prior to 1985, when the second evaporation/infiltration pond was constructed at the Sewage Treatment Plant, overflows into the South Fork of the Puerco River occasionally occurred during periods of low evaporation, heavy rainstorms, and snow falls.[34] The result of these events may be some contamination of sediments, even though surface waters are not continually present at those locations.

The only currently non-ephemeral surface water body on the installation is Lake McFerren. While the details of activities associated with the nearby former Pershing missile test launch site are not known and the current recreational activities near the lake seem benign, it is possible that the lake received some contaminated runoff.

4.3 RELEASES TO SOIL

Some areas requiring environmental evaluation in the Administration Area are known to have resulted in releases to the soil. These include:

- The POL dump, or waste discharge area, was reported to have contained soil saturated with oil prior to coverage with uncontaminated soil in 1975.

- Oil-stained soils in the Storage Yard appear to be the result of leaky drums stored there -- the contents of which are unknown but are presently undergoing analysis.

- A small quantity of neutralized acid is known to have been disposed of in the sump leading to the storm drain at Bldg. 5. Waste water from the car wash has also been discharged in this area.

- PCBs were spilled in Bldg. 11.

Other areas requiring environmental evaluation in the Administration Area are suspected to have resulted in releases to the soil. These include:

- The soils at the bottom of the settling and evaporation/infiltration ponds and sludge drying areas at the Sewage Treatment Plant are suspected to have received contaminants.

- It is suspected that the Fire Training Pit received organic solvents, diesel fuel, and oils.

- Wastes from the cesspools are suspected to have been released to the soil.

- The storm drainage ditch in and round several buildings in the Administrative Area is suspected of having received releases in the past from floor drains of waste oils, and possibly solvents.

Some areas requiring environmental evaluation in the Workshop Area are known to have resulted in releases to the soil. These include:

- The TNT leaching beds, though some contaminated soils have been removed from them, are known to contain explosive contaminants.

- The Acid Waste Holding Pond contains pesticide- and PCB-contaminated soil.

- A soil sample from the Current Landfill showed traces of pesticides and Aroclor 1016.

Other areas requiring environmental evaluation in the Ammunition Workshop Area are suspected to have resulted in releases to the soil. These include:

- The pits at the Deactivation Furnace could be a source for hazardous material releases from phosphoric acid operations and soils may be contaminated with metals, propellants, and explosives from earlier operations.

- The current landfill may contain contaminants -- cans of paint and suspected asbestos containing materials were observed near the active portion. It is suggested that sludge from the drying beds at the sewage treatment plant was disposed of here.

- The PCP-treated wooden boxes in the vicinity of Bldgs. 501, 515, and 522 are suspected of contaminating the underlying soil with dioxins and furans.

- Building 537 and the soil surrounding it are suspected of receiving releases of pesticides stored therein.

- Above-ground steam pipes from power plants to various buildings in the Workshop Area appear to be wrapped in asbestos-containing material which has deteriorated in some locations (e.g., Bldg. 530). These pipes are suspected of having released asbestos to the soil below them.

There are no known releases in the magazine/igloo areas, but the interiors of the structures are suspected to contain dust contaminated with explosives.

Some areas requiring environmental evaluation in the Demolition and Burning Area are known to have resulted in releases to the soil. These include:

- Unexploded ordnance is known to exist in the soils in and around the fenced demilitarization area.

- Demolition craters or pads are known to have soils containing explosives and cadmium.

- The soils in the Burning Grounds (present and old) are known to contain explosives, barium, lead, and cadmium.

- The soils in the residue piles are known to contain explosives and metals.

- The soils among the debris in Fenced-Up Horse Valley are known to contain explosives.

Another such area, in the Demolition and Burning Area, is suspected of having released explosives and heavy metals to the soil: the Old (abandoned) Demolition Landfill area.

An AREE in still another FWDA location is known to have resulted in releases to the soil:

- The soils in the functional test are in the central eastern portion of the installation are known to have shrapnel on the surface and probably UXO.

Areas requiring environmental evaluation in other locations in FWDA are suspected to have resulted in releases to the soil. These include:

- The soils in the functional test area in the north eastern portion of the installation are suspected to contain subsurface UXO.

- All USTs for fuel oil are relatively old and suspected of leaking, and several above ground tanks are suspected of contaminating the soil below them.

- The soils at the pistol range are suspected of being contaminated with lead and powder residues.

- Two headstones at the Ballistic Missile Test Site (BMTS) are reported to mark the locations of buried missile engines.

- The old sanitary closed landfill is suspected of containing hazardous materials.

- The old trash burning area is suspected to contain hazardous materials.

4.4 RELEASES TO AIR

Demolition and open burning activities, now permitted on an interim basis, released explosive-contaminated dust to the air almost daily since the 1940s. Moreover, activities in the Ammunition Workshop Area, such as the Deactivation Furnace, contributed atmospheric emissions in the past. While possibly degrading local air quality in the immediate vicinity of the release, the primary manifestation of these releases has been fallout, contributing to soil contamination.

5 PRELIMINARY ASSESSMENT CONCLUSIONS

The Fort Wingate Depot Activity does not require any emergency remedial actions. There are, however, instances of known or suspected releases of hazardous, or potentially hazardous, materials to the environment at FWDA that require additional investigation or remedial action before the property can be released for unrestricted use.

The Administration Area contains a number of areas requiring environmental evaluation that may have released contaminants to the environment. The storm drainage system in this area may have received wastes in the past from individual buildings via sumps and floor drains. The soils in the system and potential release locations at buildings should be investigated. Specific locations of known or suspected releases that require clean-up or confirmation of suspected contamination include:

- Maintenance Shops (Bldgs. 5 and 15)
- Storage Yard
- Locomotive Shop
- Fire Training Area
- Covered POL Waste Disposal Area
- Sewage Treatment Plant
- Septic Tanks and Cesspools
- PCB Transformer Storage Areas (Bldgs. 2, 11, and 22)
- Pesticide Storage (Bldg. 29)

The Ammunition Workshop Area has been known to have significant soil contamination at the TNT leaching beds (Bldg. 503), the Acid Waste Holding Pond (Bldg. 515), and the Deactivation Furnace site (Bldg. 530). Other buildings in the 500 area, such as power plants and active workshops, should also be investigated for potential releases. Other areas requiring environmental evaluation in the area that are suspected of releasing hazardous materials are:

- PCP-Treated Wood Box Storage Areas
- Pesticide Storage (Bldg. 537)
- Current Landfill.

The 10-sector Magazine Area contains 731 igloos (earth-covered magazines) and 12 standard magazines. These are not known to be the sites of any releases. However, fugitive explosive dusts from over 40 years of operation are suspected sources of

contamination; these could be a problem. Appropriate investigations and, if necessary, decontamination measures should be undertaken prior to the release of these property areas.

The Demolition and Burning Area contains known substantial soil contamination at several specific locations. These include:

- Demolition craters and pads
- Burning grounds (the one presently used and the Old Burning Ground)
- Residue piles
- Fenced-Up Horse Valley
- Old (abandoned) Demolition Landfill area.

Beyond the contamination problems at these specific locations of the Demolition and Burning Area is a potentially widespread problem of unexploded ordnance within, and outside of, the presently fenced area. The area in general must be cleared of UXO prior to release of the property for unrestricted use.

Several other areas requiring environmental evaluation throughout the installation are sites of known and potential releases of hazardous substances that should be investigated further. These include:

- Functional test areas in the central eastern and north eastern portions of the installation
- Pistol range
- Missile Test sites, particularly the Ballistic Missile Test Site (BMTS)
- Old (abandoned) Demolition Landfill
- Old Burning Ground.

All underground storage tanks for fuel oil throughout the installation are relatively old and suspected of leaking, and several above-ground tanks are suspected of contaminating the soil below them. Investigation of tank conditions and appropriate removal with sampling should be undertaken.

The age of the buildings and visual evidence suggests that asbestos-containing materials have been used in construction and externally for steam pipe wrap. Demolition of some buildings in the Ammunition Workshop Area may have already involved the improper disposal of the material. A survey of the installation for asbestos-containing materials should be conducted.

Building surveys for radon and lead-based paint are appropriate. The geologic setting is such that radon infiltration into buildings is possible. The age of buildings suggests that lead-based paints were probably used at one time.

Most of the known and suspected contamination associated with releases at FWDA involves soil contamination. It is suspected that the shallow alluvial groundwater aquifer may have received some of this contamination either through leaching or infiltration of surface runoff. This aquifer is spatially and temporally discontinuous, and past attempts to sample it have produced limited results. However, because of the suspected releases to this aquifer from the Administration, Ammunition Workshop, Demolition and Burning Grounds, and other areas, a comprehensive effort should be undertaken to investigate potential contamination of this aquifer. The deep aquifer appears significantly less threatened, but its quality should be confirmed as well.

The southern portion of the installation contains few areas requiring environmental evaluation -- apart from the Demolition and Burning Grounds, only the former missile test areas can be so classified. The southern portion may therefore be more immediately suitable for release for unrestricted use than the northern portions of the installation. The primary concern associated with such an action is that the UXO in the buffer areas around the Demolition and Burning Grounds be cleared. Presently, the exact extent of that threat is unknown. The quality of water and bottom sediments in Lake McFerren should be investigated prior to release.

6 PRELIMINARY ASSESSMENT RECOMMENDATIONS

As a result of the enhanced preliminary assessment of Fort Wingate Depot Activity, the following recommendations are made with regard to the release of the property for unrestricted use:

Administration Area

1. Test sediments in the storm drainage system in the vicinity of building drain inflows and any settling areas for oil, grease, solvent, pesticide, and metals contamination.

2. Investigate individual buildings for potential contamination, particularly:

   - Maintenance Shop (Bldg. 5) -- for oil, grease, solvent, PCB, and metals contamination.

   - Maintenance Shop (Bldg. 15) -- for oil, grease, solvent, PCB, pesticide, and metals contamination.

   - Locomotive Shop (Bldg. 11) -- for oil, grease, solvent, PCB, aldehyde, alkali, and metals contamination.

   - Building 29 for pesticide contamination

   - PCB Transformer Areas (Bldgs. 2, 11, and 22) -- for possible PCB leaks, and in Bldg. 11 to determine the extent of residual contamination from known leak.

3. Test soils and concrete pads, particularly stained areas, in the Storage Yard for contamination from oils, batteries, and solvents.

4. Test soils in the Fire Training Area for contamination with waste oils and solvents.

5. Test soils in the Covered POL Waste Disposal Area for contamination with waste oils and solvents.

6. Test the sediments in the infiltration/evaporation ponds and the underlying soils of the sludge drying pits at the Sewage Treatment Plant for metals and other contaminants. Investigate the pink solution found in the ponds; sample and analyze the solution if it is present. Additionally, test ash from the incinerator to ensure that it contains no hazardous constituents.

7. Remove the abandoned septic tanks in the Administration Area and evaluate the condition of those outlying areas. Test the soils there and at the associated cesspool/drainfield locations for contamination.

Workshop Area

8. Test oils and sediments in the storm drainage system in the vicinity of building drain inflows and any settling areas for explosive, oil, grease, solvent, pesticide, and metals contamination.

9. Undertake remedial investigations for the known soil contamination problems associated with operations at:

   - TNT Leaching Beds (Bldg. 503)
   - Acid Waste Holding Pond (Bldg. 515), including soil tests in and around the acid pits.
   - Deactivation Furnace (Bldg. 530)

10. Test the soil underlying the PCP-treated wooden boxes (outside of Bldgs. 501, 515, and 522) for the presence of dioxins and furans.

11. Test the interior surfaces of Bldg. 537 and surrounding soils for pesticide contamination.

12. Inspect other buildings, such as power plants and active workshops, in the Workshop Area for potential releases.

13. Investigate the Current Landfill by testing soils, and leachate if present, for explosive, oil, grease, solvent, pesticide, PCB, and metals contamination. Improve present practice at the landfill by tightening the controls on the materials disposed of there by restricting access or other means.

Magazine Area

14. Employ appropriate measures for investigation and decontamination, if needed, of explosive-contaminated dusts at all igloos and standard magazines.

Demolition and Burning Area

15. Clear the area of UXO -- the area swept should extend outside of the fenced area and well into the buffer zones.

16. Test soils and sediments in the natural drainage system in the area for explosive, oil, grease, solvent, pesticide, and metals contamination.

17. Undertake remedial investigations for the known and extensive soil contamination problems associated with operations at:

    - Demolition craters and pads
    - Burning Grounds (present and old)
    - Residue piles
    - Fenced-Up Horse Valley
    - Old (abandoned) Demolition Landfill area.

Other Specific Locations

18. Test soils and sediments in the natural drainage systems and in Knudson Lake and the South Fork of the Puerco River for explosive, oil, grease, solvent, pesticide, and metals contamination.

19. Clear the Functional Test Area in the east-central portion of the installation of unexploded (UXO). Test the soils there and at the other Functional Test Area in the northeastern portion of the installation for explosive and metal contamination.

20. Test the soils at Pistol Range for lead contaminants.

21. Test the soils at the missile test sites for contamination with propellents and solvents. Investigate the area marked with headstones at the BMTS site and excavate or sample, if appropriate.

22. Test the quality of water and bottom sediments in Lake McFerren.

23. Investigate the extent of the Old Closed Landfill and test soils, and leachate if possible, for explosive, oil, grease, solvent, pesticide, and metals contamination.

24. Test soils and sediments in Old Trash Burning Ground for explosive, oil, grease, solvent, pesticide, and metals contamination.

Geographically Dispersed Problems

25. Investigate the conditions of all underground and above-ground fuel storage tanks. Remove and dispose of abandoned tanks following accepted practice and test soils for contamination.

26. Conduct an asbestos survey covering all portions of the installation.

27. Complete the radon survey of buildings.

28. Conduct a survey of lead-based paint on and in buildings.

29. Investigate the potential groundwater contamination of portions of the shallow aquifer under the installation below areas of soil contamination and waste infiltration.

30. Confirm the quality of water in the deep aquifer from available wells on the installation.

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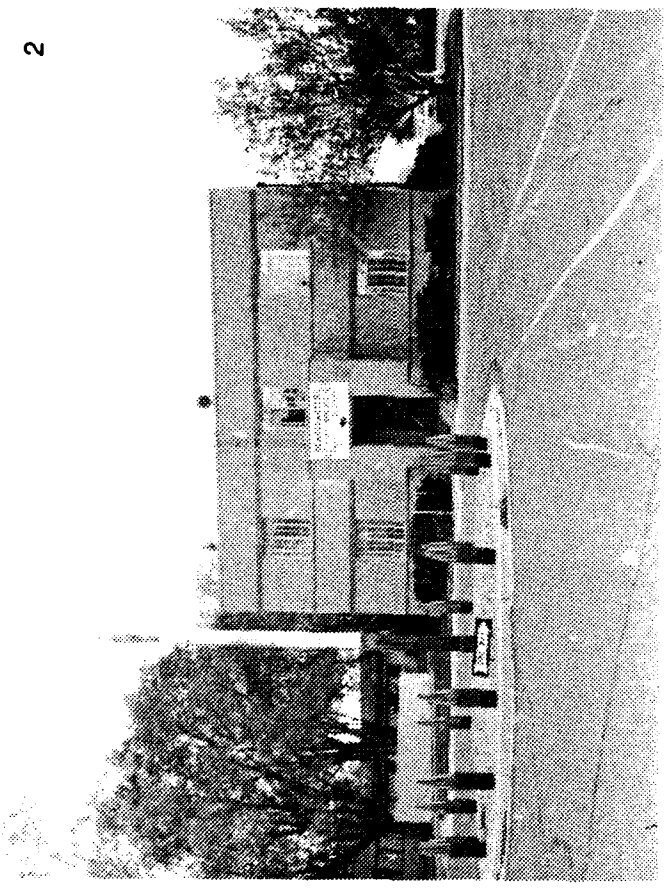
APPENDIX:

PHOTOGRAPHS



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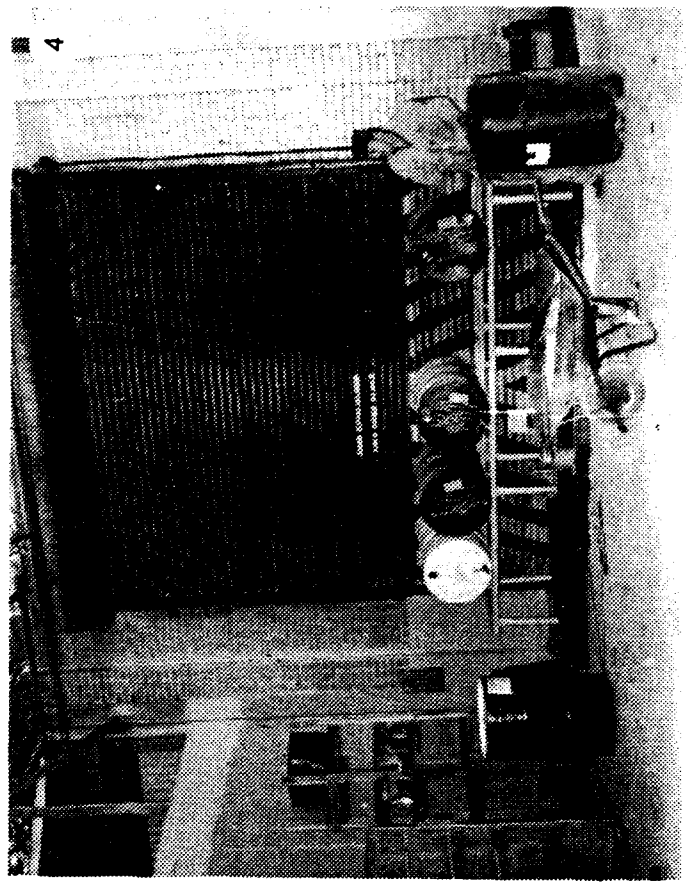

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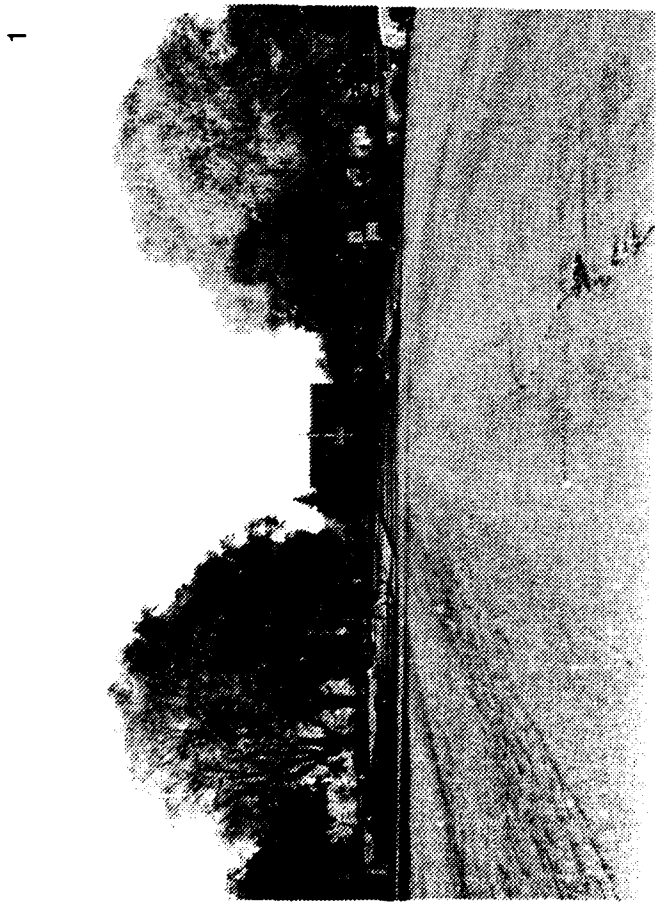

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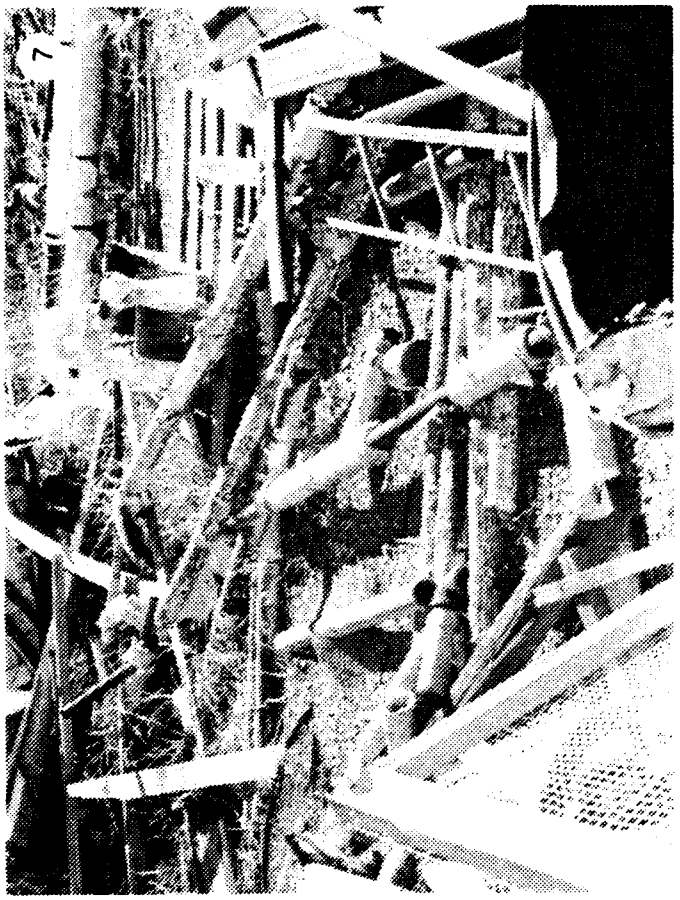
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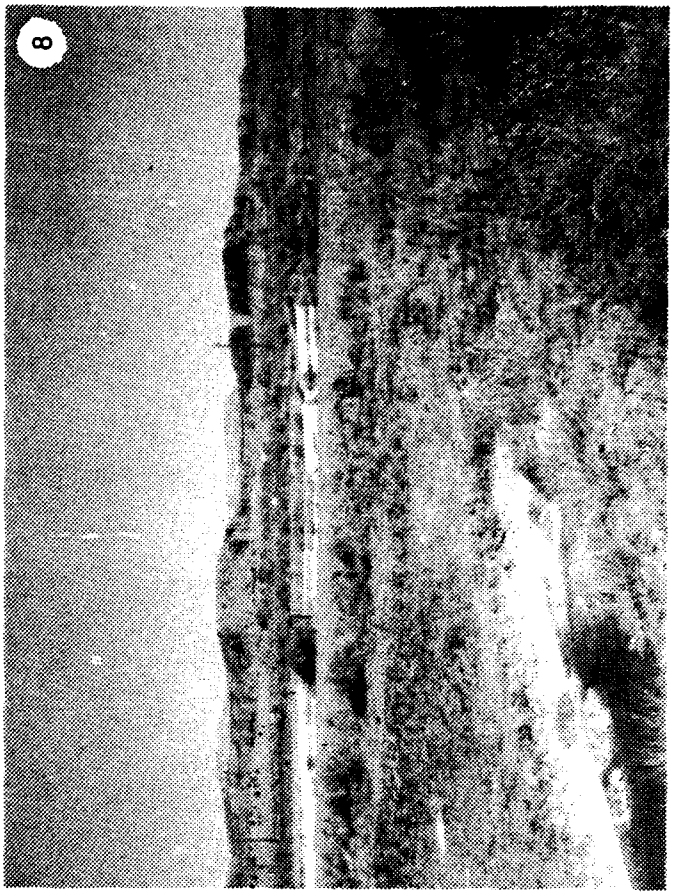
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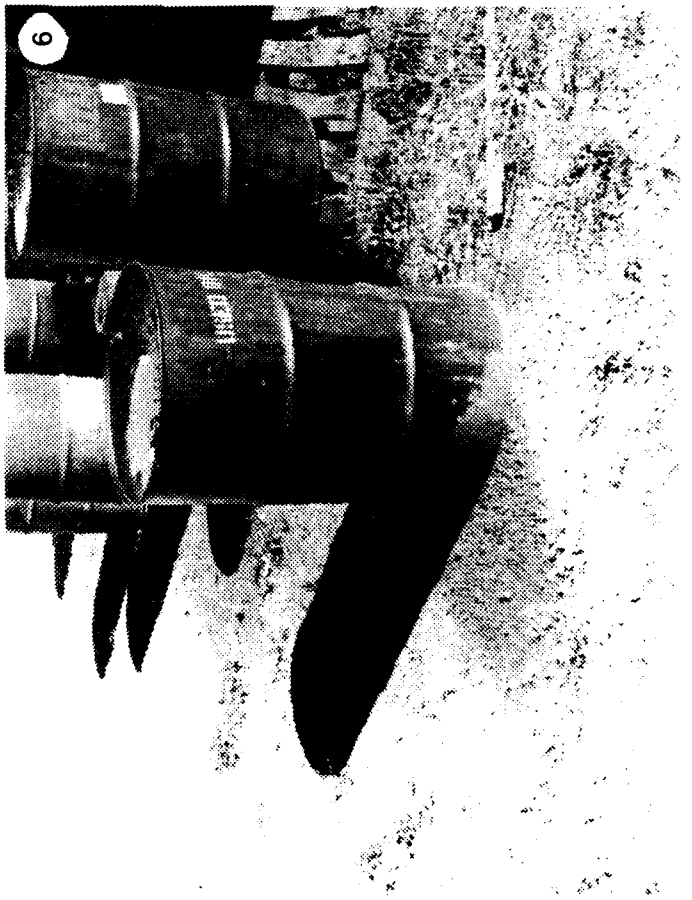
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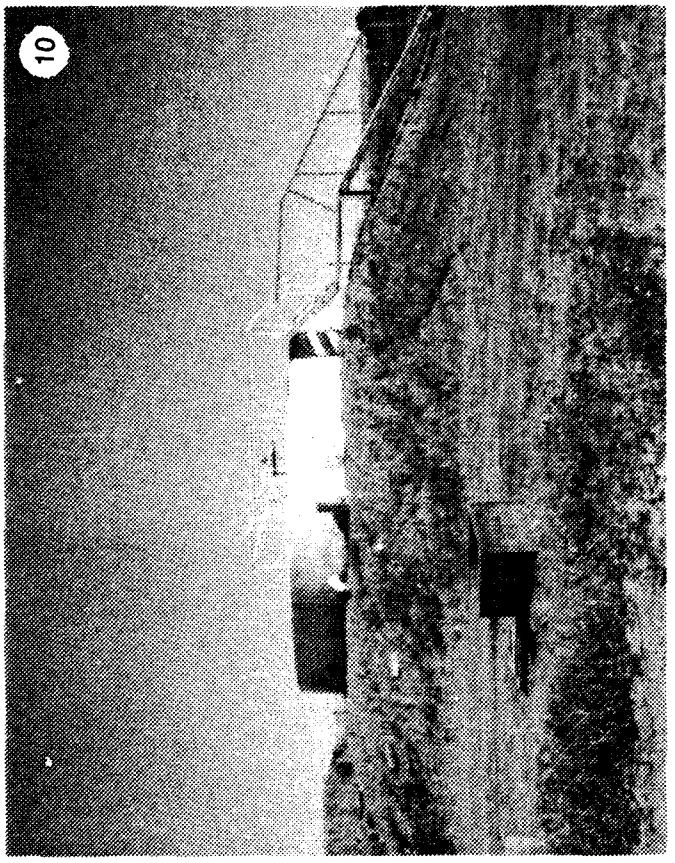
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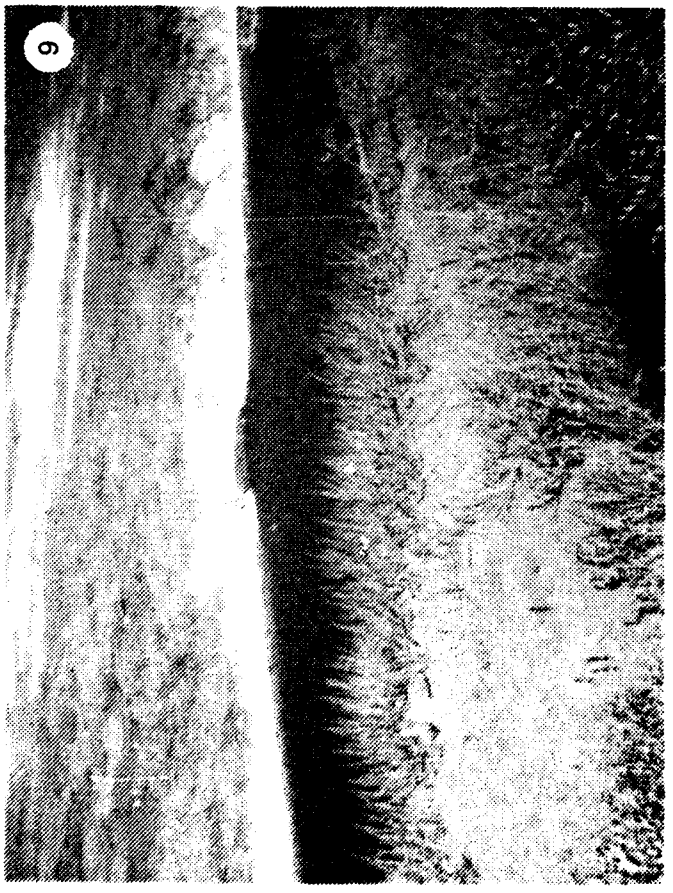
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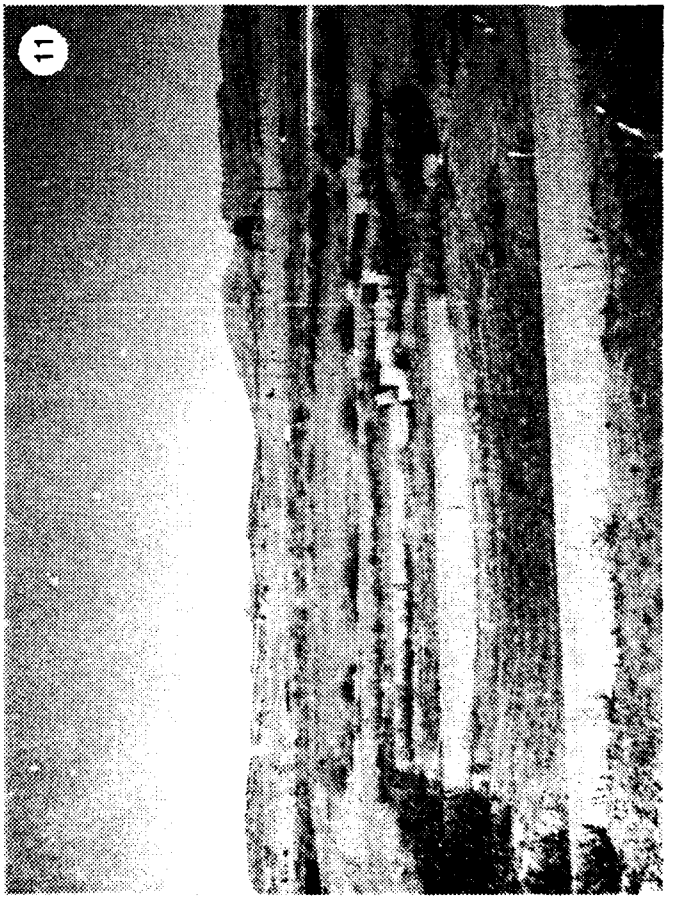
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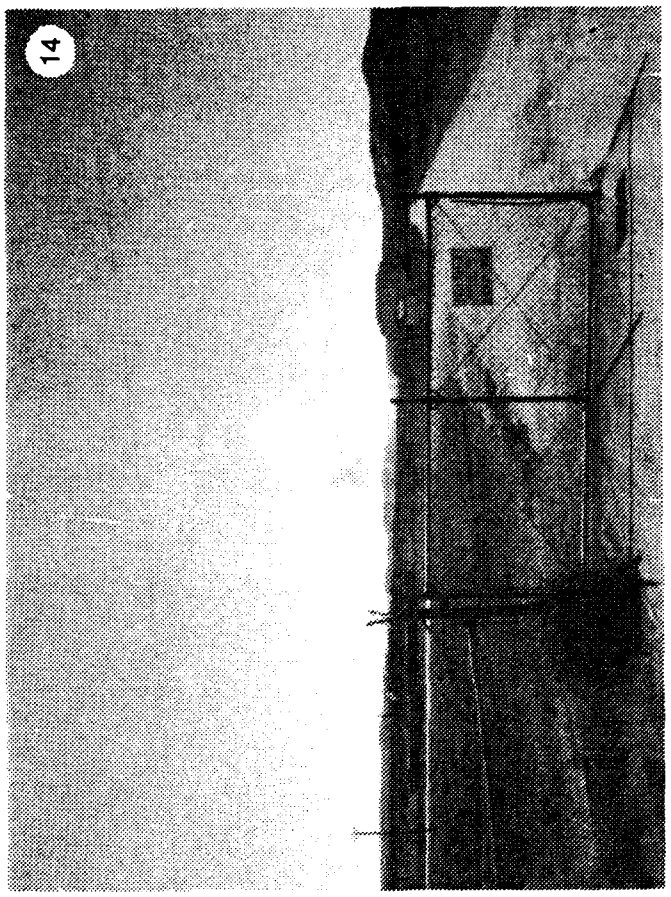
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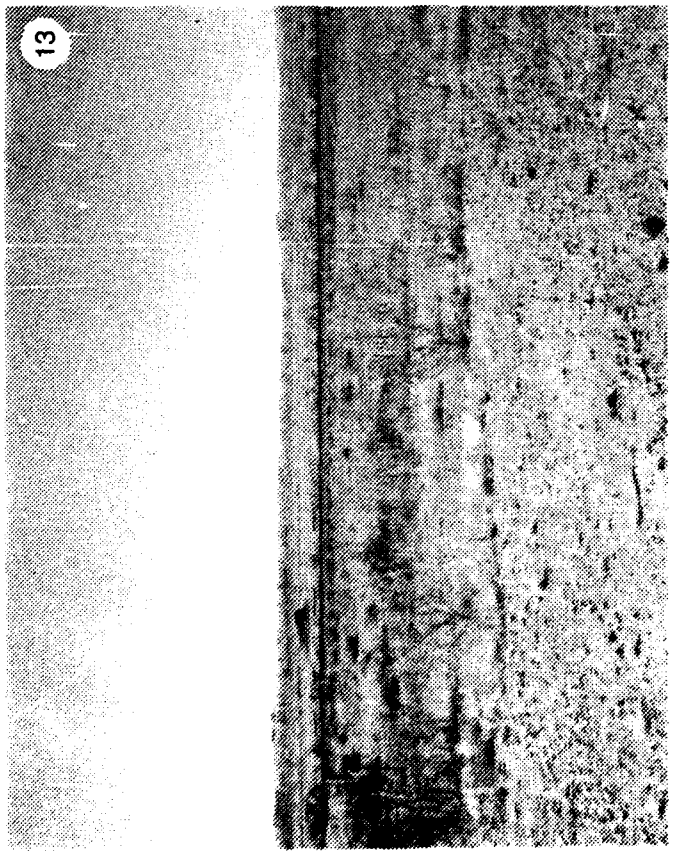
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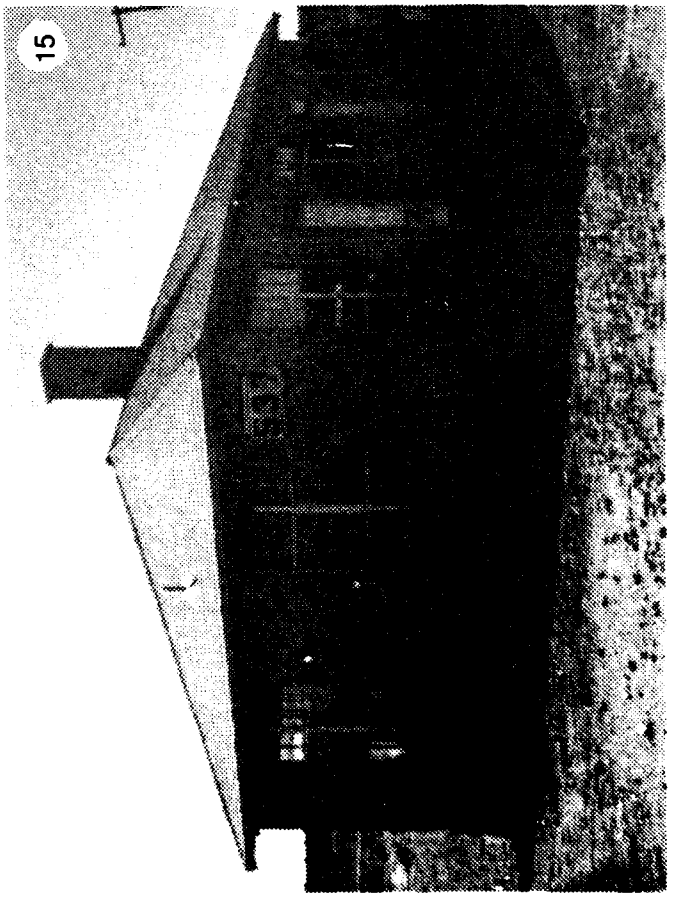
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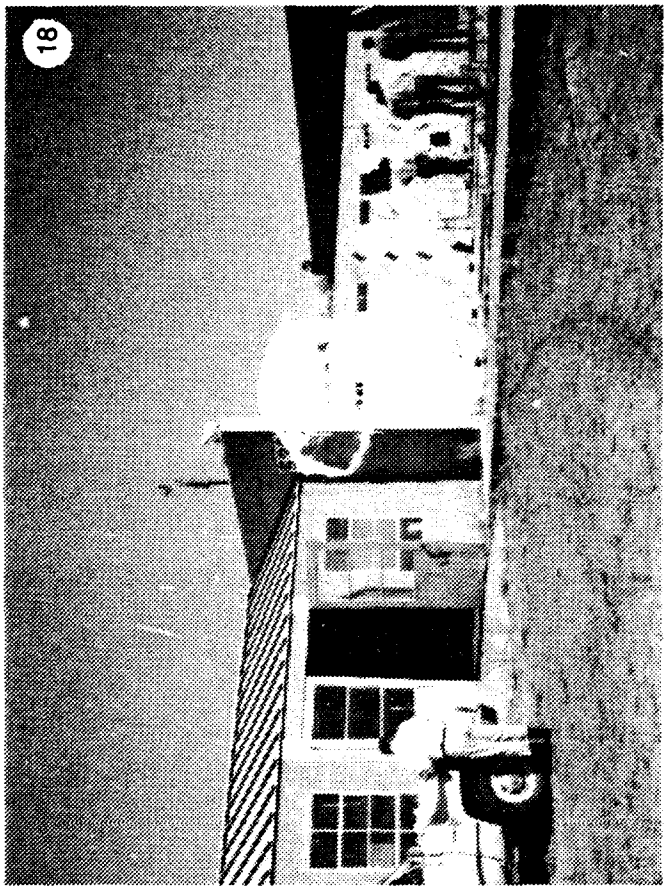
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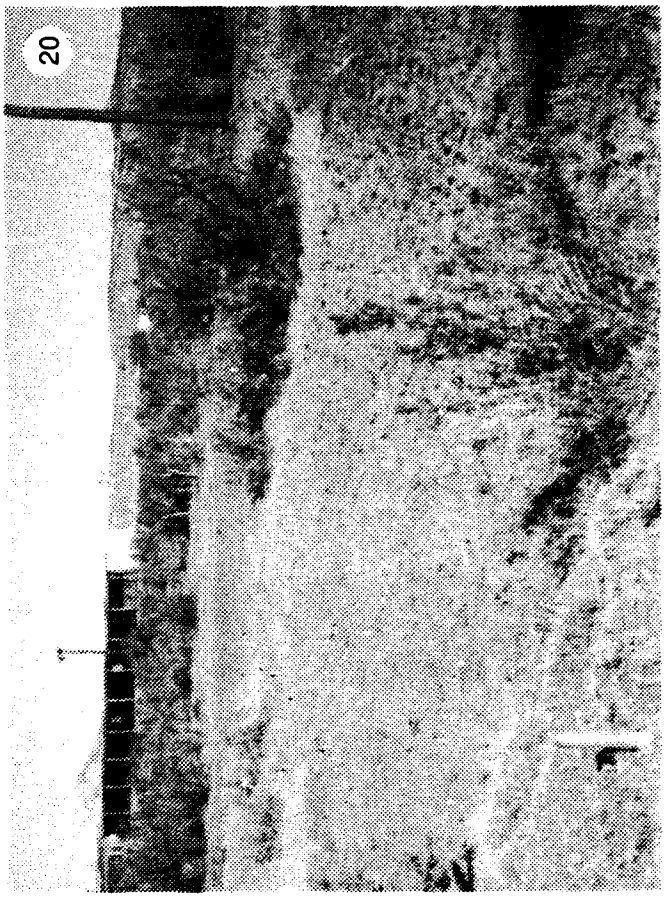
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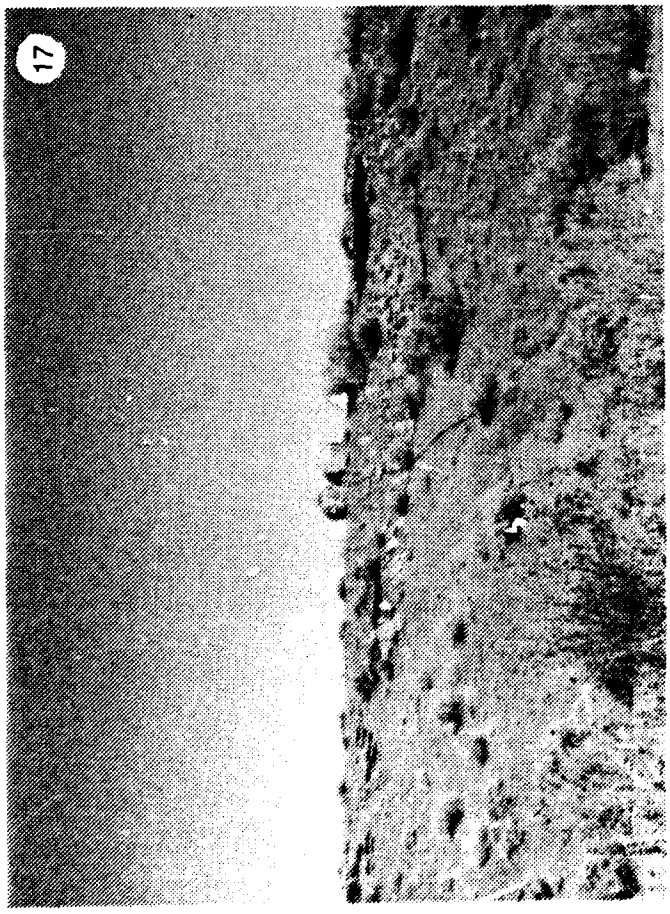
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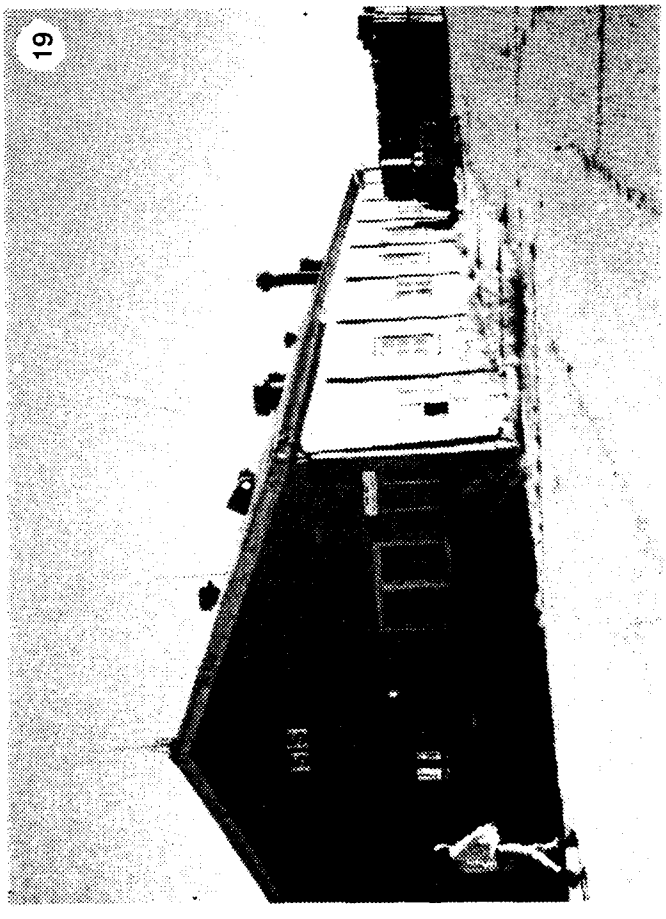
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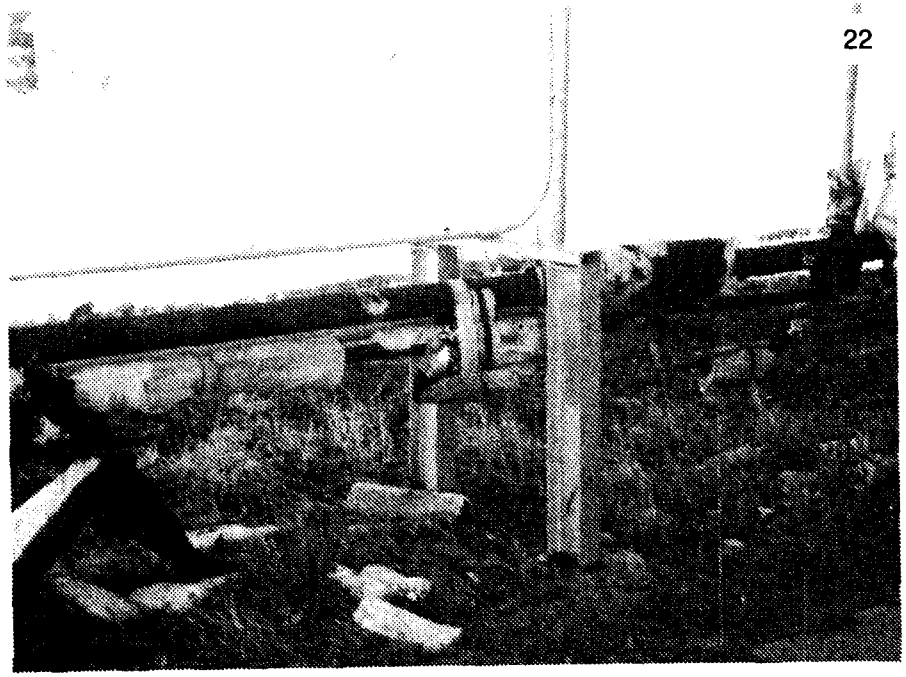

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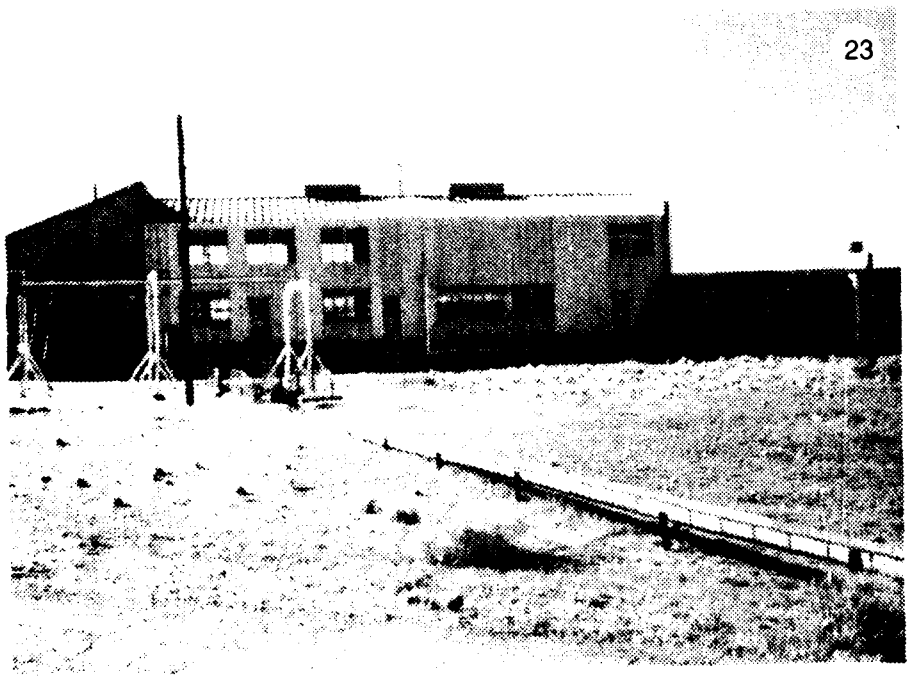

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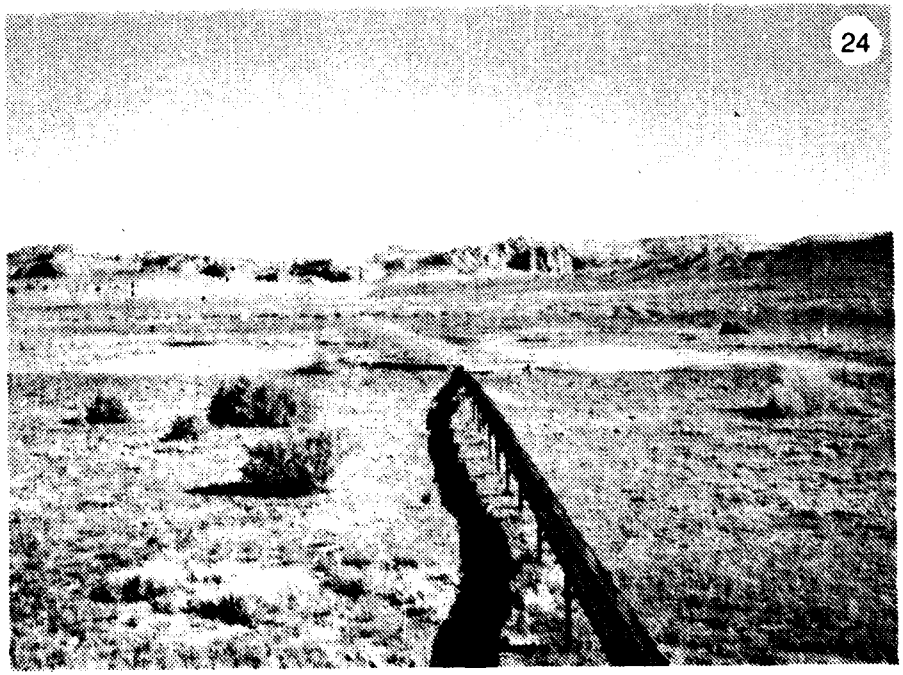

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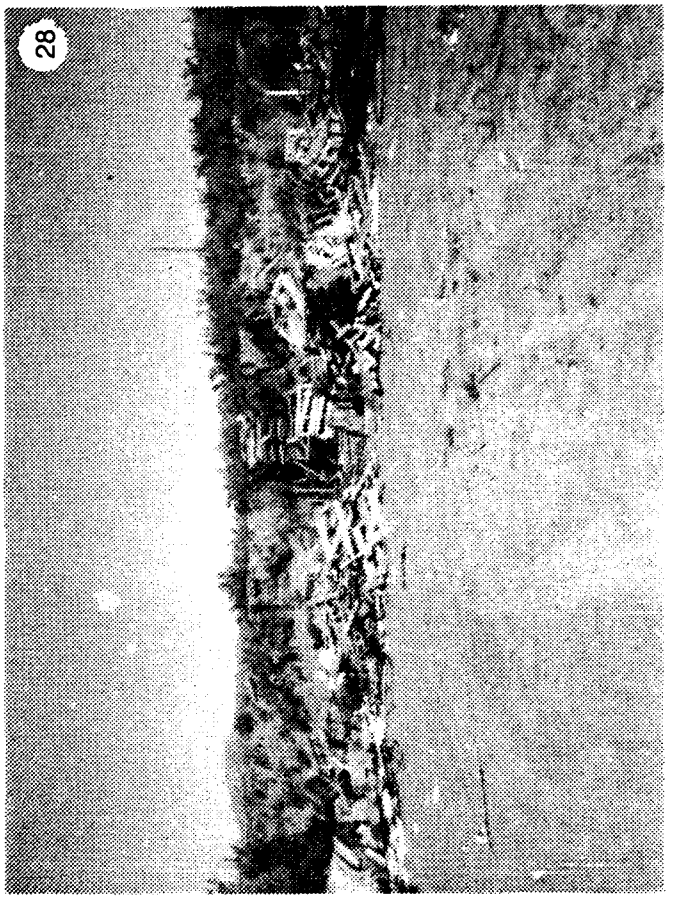
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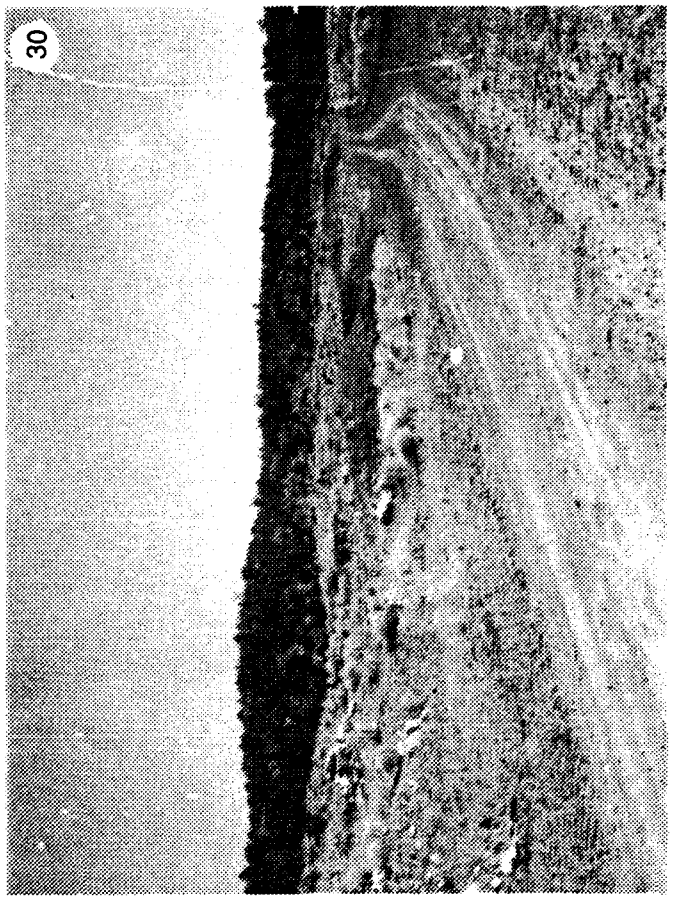
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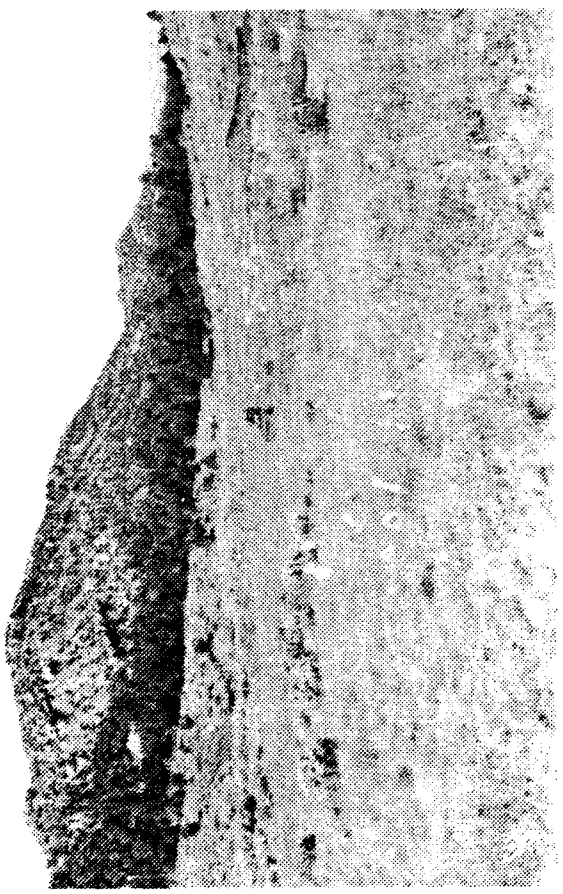
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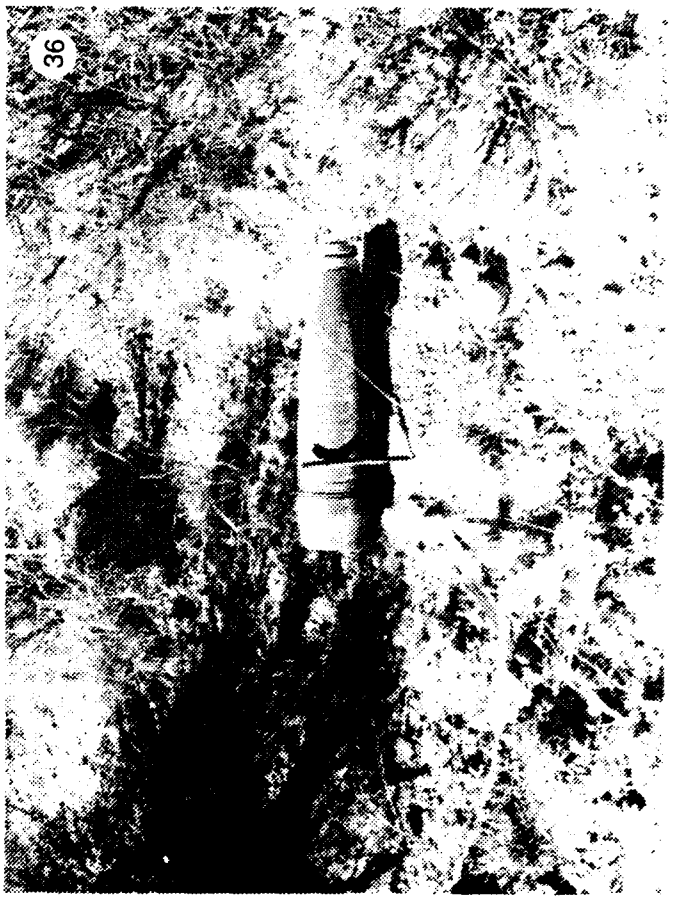
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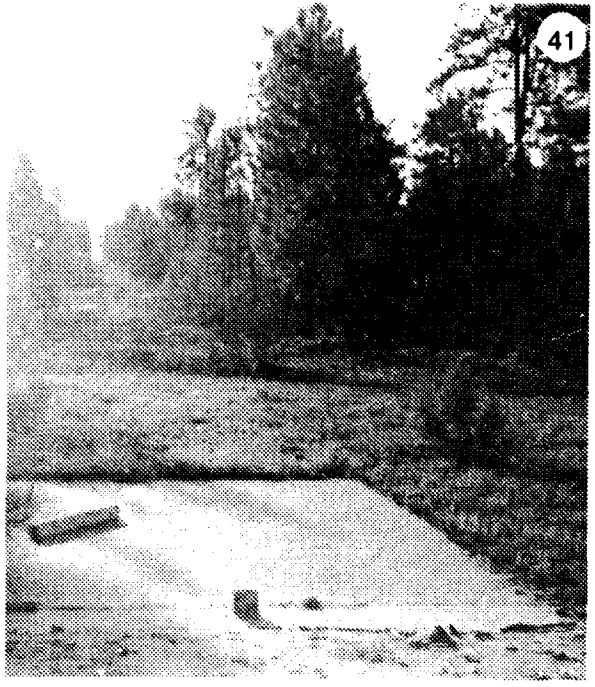

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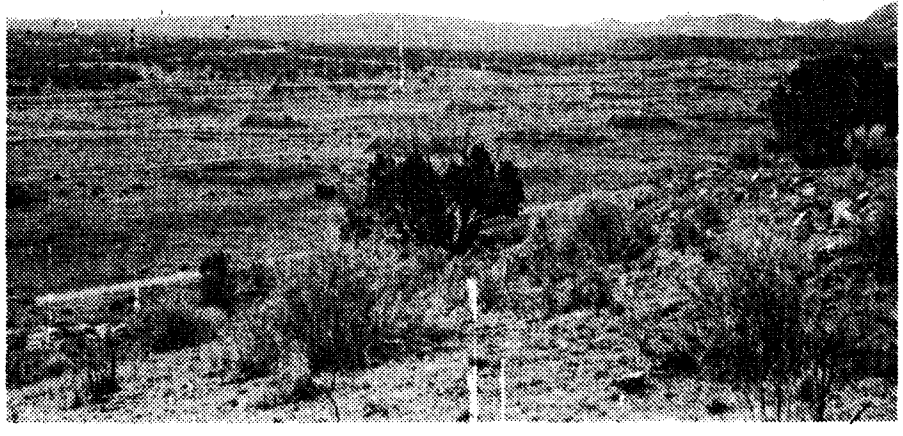

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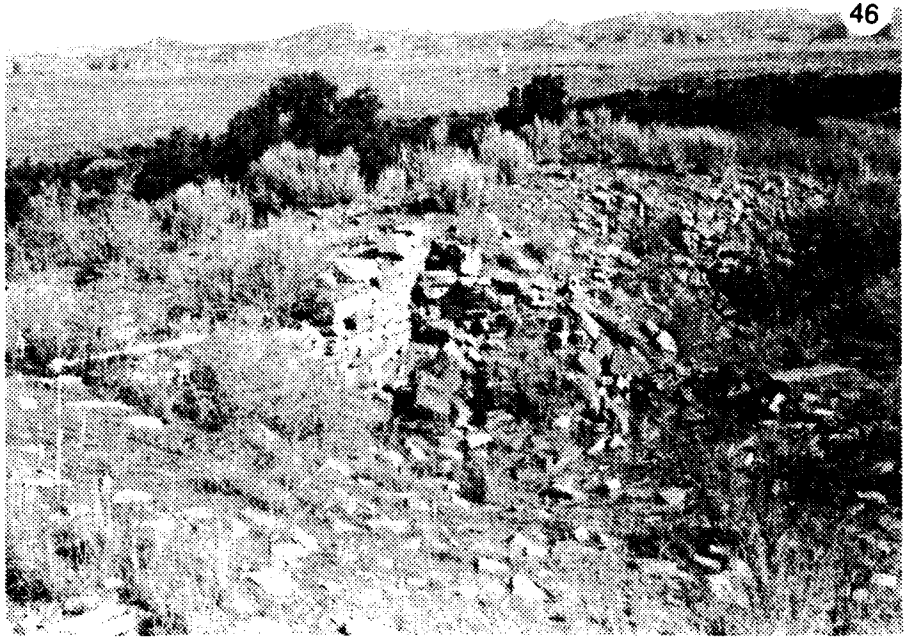

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IDENTIFICATION OF PHOTOGRAPHS

1. View of Administration building, Bldg. 1, from front gate
2. Administration, Bldg. 1
3. View of entrance road from Administration, Bldg. 1
4. Oil and solvent tanks in Maintenance Bldg. 5
5. Storage yard (west of Bldg. 15)
6. Used oil drums in storage yard
7. Pipe insulation debris in storage yard
8. Pink solution found in sewage treatment evaporation lagoon
9. Pink solution found in sewage treatment evaporation lagoon
10. Imhoff tank in sewage treatment plant
11. Sludge beds in sewage treatment plant
12. Above-ground asphalt storage tanks near old coal field
13. Suspected POL dump site
14. Entrance to restricted area (smoke from daily detonation)
15. Pesticide storage, Bldg. 537
16. Open bags of soda ash inside Deactivation Bldg. 530
17. Above-ground diesel fuel storage tanks north of Bldg. 530
18. Deactivation Bldg. 530, with two above-ground diesel fuel storage tanks
19. Building 515 ammunition painting facility (showing PCP-treated boxes)
20. Acid pond beside Bldg. 515
21. Piping in 500 area, showing looseness of suspected asbestos insulation
22. Piping in 500 area, showing looseness of suspected asbestos insulation
23. Drainage trough leading to leaching beds

24. TNT leach field (eastern half)

25. TNT leach field (western half)

26. Drainage trough entering leaching beds

27. Road into current landfill

28. Refuse in current landfill

29. Old empty drums in current landfil

30. Road into Demolition Area

31. Demolition Area, showing detonation pit

32. Pit before preparation for detonation

33. Residue pipe debris in Demolition Area

34. Fenced-Up Horse Valley -- site of shrapnel

35. Old residue pile in Fenced-Up Horse Valley

36. Shrapnel found in Fenced-Up Horse Valley (west of Demolition Area)

37. Shrapnel found in Fenced-Up Horse Valley (west of Demolition Area)

38. Lake McFerren

39. Lake McFerren from dam

40. Headstones marking reported burial sites of missile engines

41. BMTS launch pad

42. Shrapnel in grass at functional test range (Site 15 on Fig. 2.4)

43. Shrapnel in grass at functional test range (Site 15 on Fig. 2.4)

44. Southwest view of igloos (C Area) from Anasazi Site

45. Northview of igloos (B Area) from Anasazi Site

46. Anasazi Site

47. Anasazi Site